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NATIONAL DAM SAFETY PROGRAM. LAKE MINTAHAMA DAM (MO 20280), VER--ETC(U)
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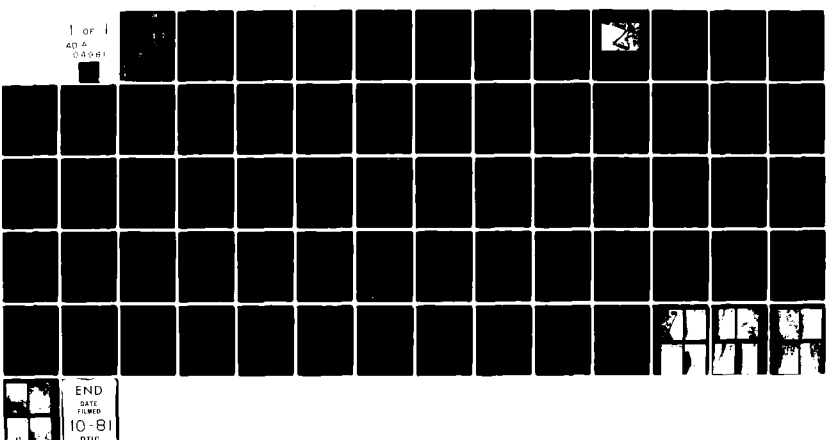

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VERDIGRIS-NEOSHO RIVER BASIN

LAKE MINTAHAMA DAM

NEWTON COUNTY, MISSOURI

MO 20280

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MARCH, 1981

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Lake Mintahama Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Lake Mintahama Dam (MO No. 20280).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. The combined spillway capacity will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division — 12 MAY 1981 (Date)

APPROVED BY: SIGNED
Colonel, CE, District Engineer — 14 MAY 1981 (Date)

VERDIGRIS-NEOSHO RIVER BASIN

LAKE MINTAHAMA DAM
NEWTON COUNTY, MISSOURI
MISSOURI INVENTORY NO. 20280

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Anderson Engineering, Inc., Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

MARCH, 1981

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
SUMMARY

Name of Dam: Lake Mintahama
State Located: Missouri
County Located: Newton
Stream: Beef Branch
Date of Inspection: November 19, 1980

Lake Mintahama Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of this inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately two miles downstream of the dam. Located within this zone are several dwellings and a trailer court containing approximately fifteen trailers.

The dam is in the small size classification, since the maximum storage capacity is greater than 50 ac-ft but less than 1,000 ac-ft.

Our inspection and evaluation indicate that the combined spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The combined spillways will pass 10 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering the small height of the dam and the low reservoir storage capacity,

50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-year flood (1 percent probability flood) will overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being exceeded in any given year. The 10-year flood (10 percent probability flood) will not overtop the dam. The 10 percent probability flood is one that has a 10 percent chance of being equalled or exceeded in any given year.

The embankment was in fair condition. Deficiencies visually observed by the inspection team were: (1) Seepage at and beyond the downstream toe of the slope; (2) Brush and tree growth on the downstream slope and at the principal spillway outlet pipe; (3) Lack of wave protection for the upstream embankment face; (4) Lack of a non-erodible emergency spillway control section; and (5) An ineffective trash screen at principal spillway inlet.

Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action promptly to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

Steven L. Brady, P.E.
Anderson Engineering, Inc.

Tom R. Beckley, P.E.
Anderson Engineering, Inc.

Jack Healy, P.E.
Hanson Engineers, Inc.

Nelson Morales, P.E.
Hanson Engineers, Inc.

AERIAL VIEW OF LAKE AND DAM

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE MINTAHAMA DAM
MISSOURI INVENTORY NO. 20280

TABLE OF CONTENTS

APPENDICES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of Lake Mintahama Dam in Newton County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

Lake Mintahama Dam is an earth fill structure 25 ft high and 360 ft long at the crest. The appurtenant work consists of a 24 in. diameter corrugated metal principal spillway outlet pipe with a 36 in. diameter CMP riser and an earth fill emergency spillway section at the east abutment.

Sheet 3 of Appendix A shows a plan, profile, and typical section of the embankment. Sheet 4 of Appendix A shows a profile and section of the emergency spillway.

B. Location:

The dam is located in the Northeastern part of Newton County, Missouri on Beef Branch. The dam and lake are within the Racine, Missouri 7.5 minute quadrangle sheet (Section 23, T26N, R33W - latitude 36°58.1'; longitude 94°30.4'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 25 ft and a maximum storage capacity of approximately 133 acre-ft, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification. The estimated damage zone extends approximately two miles downstream of the dam. Located within this zone are several dwellings and a trailer court containing approximately fifteen trailers. The affected features located within the damage zone were field verified by the inspection team.

E. Ownership:

The dam is owned by Ozark Area Girl Scouts Council Attention: Mr. Leroy Wilson, Executive Director.

The owner's address is 4400 McClelland Boulevard P. O. Box 2396 Joplin, Missouri 64801.

F. Purpose of Dam:

The dam was constructed primarily for recreation.

G. Design and Construction History:

Construction of the dam was started in 1969 and completed in 1971. Information regarding the construction of the dam was obtained from Mr. Leroy Wilson, Executive Director of the Ozark Area Girl Scout Council, and Mr. John Murray of John Murray Construction Company, Carthage, Missouri.

Mr. Wilson stated that the initial clearing of the dam site was done by Ameo Construction Company, Joplin, Missouri. He stated that after the core trench was excavated, John Murray Construction Company was contracted to complete the dam.

Mr. Murray stated that the core trench was excavated at the time he started construction of the dam in 1970. The trench was approximately 5 ft deep and 8 ft wide. He stated that the bottom of the core trench was excavated to a clay base. According to Mr. Murray the select material for the core and all the material for the embankment was obtained from the hillside immediately east of the embankment. Compaction of the embankment material was by use of a scraper and dozer. Mr. Murray stated that final grades were surveyed by the Neosho Soil Conservation Service under the direction of Mr. Warren George (Retired).

Mr. Wilson stated that on July 3, 1976 the pool elevation was to within 3 in. of the top of the embankment. He indicated that the emergency spillway sustained damage due to erosion. The repair to the spillway was done in 1977 by John Murray Construction Company. Mr. Murray stated that the erosion in the emergency spillway channel was approximately 12 ft deep at the centerline of the dam and 15 ft wide at the bottom of the channel. He indicated that the erosion exposed apparent bedrock in the emergency channel. Repair procedures included reconstruction of the earth spillway channel and filling in of apparent low areas along the crest of the dam. The material for the reconstruction was obtained from the hillside to the east of the dam. Mr. Murray stated that about one half the length of the dam crest was filled in about a foot in height to raise the dam to the plan elevation. Survey control was provided by SCS during the reconstruction of the spillway and crest of dam.

According to Mr. Wilson and Mr. Murray the dam was constructed in accordance with the plans provided by SCS with the exception of the elimination of the 12 in. drawdown pipe shown on the plans. This pipe was eliminated at the request of the owner. The embankment of the existing pond and the swimming pool located upstream of the current dam embankment was not removed according to Mr. Wilson.

H. Normal Operating Procedures:

All flows will be passed by the uncontrolled principal spillway pipe and riser and the earthfill emergency spillway channel. Mr. Wilson stated that the emergency channel was severely eroded when the water was to within 3 in. of the crest of the dam.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile, and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the SCS design plans and checked by the U.S.G.S. quad sheet, is approximately 590 acres.

B. Discharge at Dam Site:

(1) All discharge at the dam site is through uncontrolled spillways.

(2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 1078.7): 545 cfs

(3) Estimated Capacity of Principal Spillway: 47 cfs

(4) Estimated Capacity of Emergency Spillway: 498 cfs

(5) Estimated Experience Maximum Flood at Dam Site: Elevation 1078.5, Flow unknown, emergency spillway was severely eroded.

(6) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable

(7) Diversion Tunnel Outlet at Pool Elevation: Not Applicable

(8) Gated Spillway Capacity at Pool Elevation: Not Applicable

(9) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

All elevations are consistent with an assumed mean sea level elevation of 1073.1 for top of 36 in. CMP riser Station 5 + 12, 25 ft right of centerline (estimated from quadrangle map).

(1) Top of Dam: 1078.7 ft, MSL

(2) Principal Spillway Crest: 1073.1 ft, MSL

(3) Emergency Spillway Crest: 1076.6 ft, MSL

(4) Principal Spillway Pipe Invert at Outlet: 1056.0 ft, MSL

(5) Streambed at Centerline of Dam: 1054.0 ft, MSL

(6) Pool on Date of Inspection: 1073.1 ft, MSL

(7) Apparent High Water Mark: 1078.5 ft, MSL (as related by owner)

(8) Maximum Tailwater: Not Applicable

(9) Upstream Portal Invert Diversion Tunnel: Not Applicable

(10) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

(1) At Top of Dam: 2,050 ft

(2) At Emergency Spillway Crest: 1,850 ft

(3) At Principal Spillway Crest: 1,500 ft

E. Storage Capacities:

(1) At Top of Dam: 133 Acre-ft

(2) At Emergency Spillway Crest: 107 Acre-ft

(3) At Principal Spillway Crest: 74 Acre-ft

F. Reservoir Surface Areas:

(1) At Top of Dam: 14.0 Acres

(2) At Emergency Spillway Crest: 10.8 Acres

(3) At Principal Spillway Crest: 8.2 Acres

G. Dam:

(1) Type: Rolled Earth

(2) Length at Crest: 360 ft

(3) Height: 25 ft

(4) Top Width: 15 ft

(5) Side Slopes: Upstream to water edge varies 1V on 2.9H to 1V on 3.6H Downstream varies from 1V on 1.9H to 1V on 4.8H.

(6) Zoning: Apparently Homogeneous

(7) Impervious Core: Clay core 8 ft minimum with (information from owner)

(8) Cutoff: Key trench 5 ft deep (Information from owner)

(9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

(1) Type: Not Applicable

(2) Length: Not Applicable

(3) Closure: Not Applicable

(4) Access: Not Applicable

(5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

(1) Location: Station 3 + 12 centerline of dam

(2) Type: 24 in. diameter corrugated metal pipe with 36 in. diameter corrugated metal riser pipe

(3) Upstream Channel: Not Applicable

(4) Downstream Channel: Well defined earth channel, brush and tree lined with moderate slopes

I.2 Emergency Spillway:

(1) Location; East abutment

(2) Type: Earthfill channel, trapezoidal, 40 ft wide at crest

(3) Upstream Channel: Grass lined earth channel with moderate slopes

J. Regulating Outlets:

There are no regulating outlets associated with this dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

The dam was designed by the Soil Conservation Service. Copies of a portion of the design plans are included as Sheets 6 through 8 of Appendix A. No documentation of construction or reconstruction inspection records were available. There are no documented maintenance data.

A. Surveys:

The preconstruction, construction control, and reconstruction control surveys were conducted by the Soil Conservation Service. Field notes of these surveys were not available. Sheet 5 of Appendix A presents a plan, profile, and cross-section of the survey data obtained during the site inspection. The top of the 36 in. CMP riser was used as a site datum of elevation 1073.1. The mean sea level elevation of 1073.1 was estimated from the Racine, Missouri 7.5 minute quadrangle sheet.

B. Geology and Subsurface Materials:

The site is located in the border zone between the Ozarks and Western Plains geologic regions of Missouri. This area is characterized topographically by rolling to hilly with oak and hickory forest areas. The sedimentary rock layers exposed in the Ozarks region dip downward away from the Ozarks region and the higher and younger sedimentary deposits become the surface ledges in southwest Missouri. The soils in this region are residual from cherty and dolomitic limestones of the Mississippian age. The site is located upon an outcrop of the Warsaw formation of the Meramecian series.

Soils in the area of the dam are among this area's most common. The embankment soils are reddish-brown silty clays (CL) with chert rock fragments. The chert is from the parent material and is found in each of the soil layers of this soil series. These soils generally make good fill material when properly compacted.

The "Geologic Map of Missouri" indicates that two known faults run in a northeast-southwesterly direction through or very near the dam site. The Missouri Geological Survey has indicated that these faults are known as the Seneca faults and there is no known activity or movement. These faults in this area are generally considered to be inactive. The publication "Caves of Missouri" indicates there are four caves in Newton County and these are several miles from the dam site.

C. Foundation and Embankment Design:

No foundation and embankment design information was available. Seepage and stability analyses apparently were not performed as required in the Corps of Engineers guidelines. The contractor indicated that a core trench approximately 8 ft wide and 5 ft deep was excavated to a clay base. The embankment fill was obtained from the adjacent hillside east of the dam.

D. Hydrology and Hydraulics:

The available hydrologic and hydraulic design computations are included as Sheet 6 of Appendix A. Based on the available design information and field measurements of spillway dimensions and embankment elevations, the watershed area, lake area and storage data were obtained. The areas were verified from U.S. G.S. quad sheets and hydrologic analyses using U. S. Army Corps of Engineers guidelines were performed and appear in Appendix C.

E. Structure:

The only structure associated with this dam is the 24 in. CMP with 36 in. CMP riser. (See Sheet 3 and 8 of Appendix A.)

2.2 CONSTRUCTION:

No construction inspection data have been obtained.

2.3 OPERATION.

Normal flows would be passed by the uncontrolled principal spillway pipe and emergency spillway channel.

2.4 EVALUATION:

A. Availability:

The engineering data available are as listed in Section 2.1.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation of this structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions, including earthquake load, and made a matter of record.

C. Validity:

The available engineering design data obtained from the Soil Conservation Service are considered valid. No valid engineering data on the construction of the embankment are available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on November 19, 1980. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Steven L. Brady - Anderson Engineering, Inc. (Civil Engineer)
Tom R. Beckley - Anderson Engineering, Inc. (Civil Engineer)
Jack Healy - Hanson Engineers, Inc. (Geotechnical Engineer)
Nelson Morales - Hanson Engineers, Inc. (Hydraulic Engineer)

Mr. Leroy Wilson, Executive Director of the Ozarks Area Girl Scout Council was on site with the inspection team during part of the inspection.

Photographs of the dam, appurtenant structures, reservoir, and downstream features are presented in Appendix D.

B. Dam:

The embankment is in fair condition. The horizontal alignment of the embankment is good. The crest of the dam slopes upward from Station 1 + 00 to Station 3 + 00 and then downward to the emergency spillway channel. The difference in elevation of the low to high point along the crest is 0.7 ft in 200 ft. The crest of the dam is 15 ft wide with little to no grass cover. No surface cracking was observed along the crest of the dam.

The slope of the upstream face of the embankment varied from 1V on 2.9H to 1V on 3.6H. Good grass cover was noted along the upstream slope. No rip rap or other form of wave protection was noted along the upstream face. No significant erosion of the upstream slope was noted. On the date of inspection the lake level was at the normal pool elevation of 1073.1. According to Mr. Wilson, the lake is spring fed and the lake level is almost always maintained at normal pool elevation.

The slope of the downstream face of the embankment varied from 1V on 1.9H to 1V on 4.8H. The downstream slope of the embankment was moderate to dense brush and small tree covered. A few larger trees were noted along the toe of the slope.

No unusual movements or sloughing of the embankment were noted. No animal burrows were observed on the embankment. Due to the dense brush, inspection of the downstream slope was difficult.

The junctions of the embankment and the abutments were adequate with no observed erosion. The junctions were brush covered.

A soft marshy area with standing water was noted along the toe of the slope. This area extended from about Station 1 + 00 to Station 3 + 00 and to about 50 ft beyond the toe of the slope. No measureable flow could be detected within the marshy area. The standing water within the marshy area contained considerable iron oxide staining. No soil particle suspension was observed.

Shallow auger probes of the embankment indicated the embankment soil to consist of reddish-brown silty clay with chert fragments. The Unified Soil Classification was determined to be CL.

C. Appurtenant Structures:

C.1 Principal Spillway:

The principal spillway consisted of a 24 in. diameter corrugated metal pipe and a 36 in. diameter corrugated metal pipe riser. Installed on top of the riser pipe was an anti-vortex shield and a trash rack. Flow through the principal spillway is uncontrolled. Two logs about 6 in. in diameter and 5 ft long were observed inside the riser pipe. The logs were jammed in the riser pipe partially blocking the entrance of the principal spillway inlet pipe. No additional trash accumulation was noted. The outlet of the spillway pipe was at the toe of the slope. The plunge pool depth was about 2 ft deep. Dense brush and tree growth was observed at the spillway outlet.

C.2 Emergency Spillway:

The emergency spillway is an earth channel located at the east abutment. The approach to the spillway is clear. No significant erosion of the channel was noted. The channel appears not to have recently carried any flows. The channel has a good grass cover. A non-erodible control section was not provided. Based upon the previous failure of the spillway, and conversations with Mr. Murray who stated that during reconstruction of the emergency spillway the material placed in the channel was very difficult to achieve proper compaction, the spillway channel is considered to be very susceptible to erosion. The trapozoidal shaped spillway control section is approximately 40 ft wide.

Approximately 280 ft downstream of the centerline of the dam, an earth berm was constructed along the width of the channel. This berm was constructed to divert the channel releases into the natural valley channel and away from an adjacent property owner's land. This berm is well away from the embankment and spillway releases, and would not be expected to endanger the embankment.

D. Reservoir:

The watershed is primarily wooded with moderate slopes. No significant erosion or sloughing was noted. Siltation appears to be very minor, and is not considered to be a problem.

E. Downstream Channel:

The downstream channel is generally brush and tree lined. The principal and emergency spillway channels merge approximately 250 ft downstream of the embankment toe. The slopes of the well defined channel are moderate.

3.2 EVALUATION:

The embankment is in fair condition. Trees and brush on the dam constitute a potential seepage hazard and encourage animal burrowing. The seepage could worsen and adversely affect the embankment stability. Partial or complete blockage of the principal spillway inlet could occur with debris entering through the trash rack which could adversely affect the flow through the spillway pipe. The discharge of flows through the erodible emergency spillway channel could result in significant erosion of the channel.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no operating facilities associated with the dam. The pool level is normally controlled by rainfall, runoff, evaporation, the capacity of the uncontrolled spillways, and apparent seepage from the reservoir.

4.2 MAINTENANCE OF DAM:

The crest and upstream slope of the embankment appear to be well maintained. No additional maintenance of the dam is known to be provided.

4.3 MAINTENANCE OF OPERATING FACILITIES:

There are no operating facilities associated with this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

The tree and brush growth on the dam and the principal spillway outlet channel, seepage, lack of wave protection, lack of a non-erodible emergency control section, and ineffective trash screen are deficiencies which should be corrected. Remedial measures should be investigated by an engineer experienced in the design and construction of dams.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. Design Data:

The hydrologic and hydraulic design calculations obtained from SCS are included as Sheet 6 of Appendix A.

B. Experience Data:

No recorded rainfall, runoff, discharge, or reservoir stage data were available for this lake and watershed. Mr. Wilson stated that the emergency spillway sustained considerable erosion in 1976 when the lake level was to within 3 in. of the crest of the dam. The apparent high water line was at elevation 1078.5 (top of dam elevation is 1078.7). Our hydrologic and hydraulic analyses using U. S. Army Corps of Engineers guidelines appear in Appendix C.

C. Visual Observations:

The approaches to the principal and emergency spillways are clear. The trash screen of the principal spillway has been ineffective in preventing logs from entering the riser pipe. The outlet of the principal spillway pipe at the toe of the slope is densely covered with brush and trees. The emergency spillway channel is clear with a good grass cover. The emergency spillway channel is well separated from the embankment, and spillway releases would not be expected to endanger the dam. The emergency spillway does not contain a non-erodible section, and spillway releases could seriously erode as previously experienced. The downstream channel of the spillways is light to moderate brush and tree covered with moderate slopes.

D. Overtopping Potential:

The hydraulic and hydrologic analyses (using the U. S. Army Corps of Engineers guidelines and the HEC-1 computer program) were based on: (1) a field survey of spillway dimensions and embankment elevations; (2) a review of design data obtained from SCS; and (3) a check of the reservoir storage and the pool and drainage areas from the Racine, Missouri - Oklahoma, Kansas 7.5 Minute and Tipton Ford U.S. G.S. quad sheets.

Based on the hydrologic and hydraulic analyses presented in Appendix C, the combined spillways will pass 10 percent of th Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering the small height of the dam and the low reservoir storage capacity, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The spillways will pass a 10 percent probability flood without overtopping the dam. However, the 1 percent probability flood will overtop the dam by 0.7 ft at elevation 1079.4 with a maximum outflow of 1,197 cfs. The duration of overtopping will be 1.0 hours.

Application of the probable maximum precipitation (PMP), minus losses, resulted in a flood hydrograph peak inflow of 8,685 cfs. For 50 percent of the PMF, the peak inflow was 4,343 cfs.

The routing of 50 percent of the PMF through the spillways and dam indicates that the dam will be overtopped by 1.9 ft at elevation 1,080.6. The duration of the overtopping will be 5.7 hours, and the maximum outflow will be 3,934 cfs. The maximum discharge capacity of the spillways is 545 cfs. The routing of the PMF indicates that the dam will be overtopped by 3.1 ft at elevation 1,081.8. The maximum outflow will be 8,093 cfs, and the duration of overtopping will be 7.1 hours. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Observed features which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

The reported post-construction changes to the dam include reconstruction of the emergency spillway channel and fill placed on the eastern half of the dam crest in 1977.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment was in fair condition. Several items were noted during the visual inspection which should be investigated further, corrected or controlled. These items are: (1) seepage at and beyond the downstream toe of the slope; (2) brush and tree growth on the dowastream slope and at the principal spillway outlet pipe; (3) lack of wave protection for the upstream embankment face; (4) lack of a non-erodible emergency spillway control section; and (5) an ineffective trash screen at principal spillway inlet.

Another deficiency was the lack of seepage and stability analyses records.

The dam will be overtopped by flows in excess of 10 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

B. Adequacy of Information:

The conclusions in this report were based on review of the information listed in Section 2.1, the performance history as related by others, and visual observation of external conditions.

The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished promptly. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will continue to deteriorate and possibly could become serious in the future. The items recommended in paragraph 7.2A should be pursued without undue delay.

D. Necessity for Additional Inspection:

Based on the result of the Phase I inspection, no Phase II inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

A. Alternatives:

(1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. In either case, the spillway should be protected to prevent erosion.

B. O & M Procedures:

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.

(2) Brush and tree growth should be removed from the embankment and the spillway outlet. This should be done under the principal guidance of a professional engineer experienced in the design and construction of dams. Indiscriminate clearing methods could jeopardize the safety of the dam.

(3) The seepage area at and beyond the downstream toe of the slope should be investigated by a professional engineer experienced in the design and construction of dams. As a minimum, these areas should be inspected periodically in an effort to detect an increase in the quantity of seepage or any indication that soil particles are being carried by the water. Remedial measures may be required.

(4) Wave protection, such as rip rap, should be provided for the upstream face of the embankment.

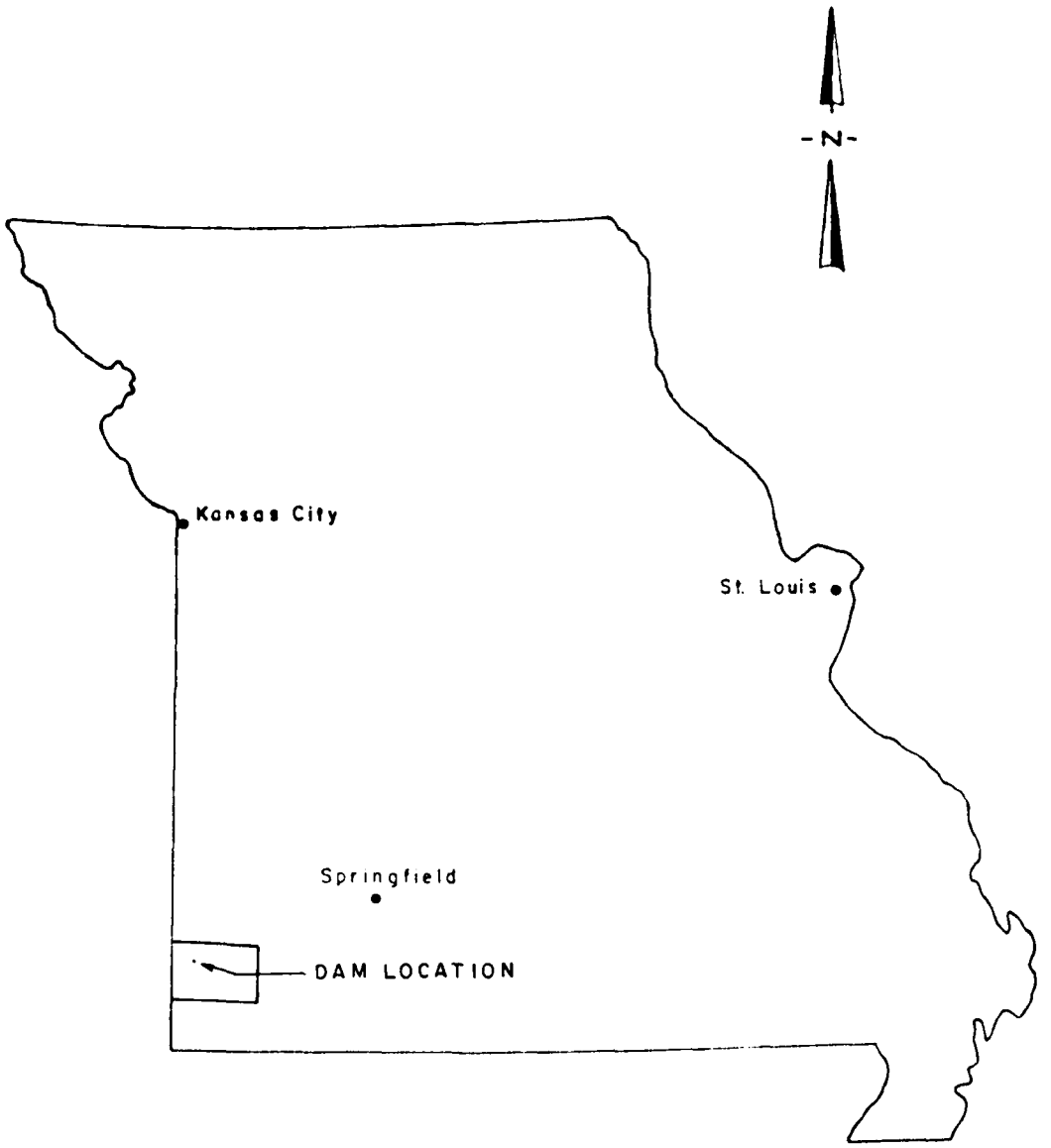
(5) The trash screen should be modified and maintained to prevent potential blockage of the principal spillway.

(6) A non-erodible control section should be provided for the emergency spillway.

(7) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

APPENDIX A

Dam Location and Plans



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LOCATION MAP

LAKE MINTAHAMA DAM
NEWTON COUNTY, MISSOURI
MO. I.D. No. 20280

SHEET 1, APPENDIX A

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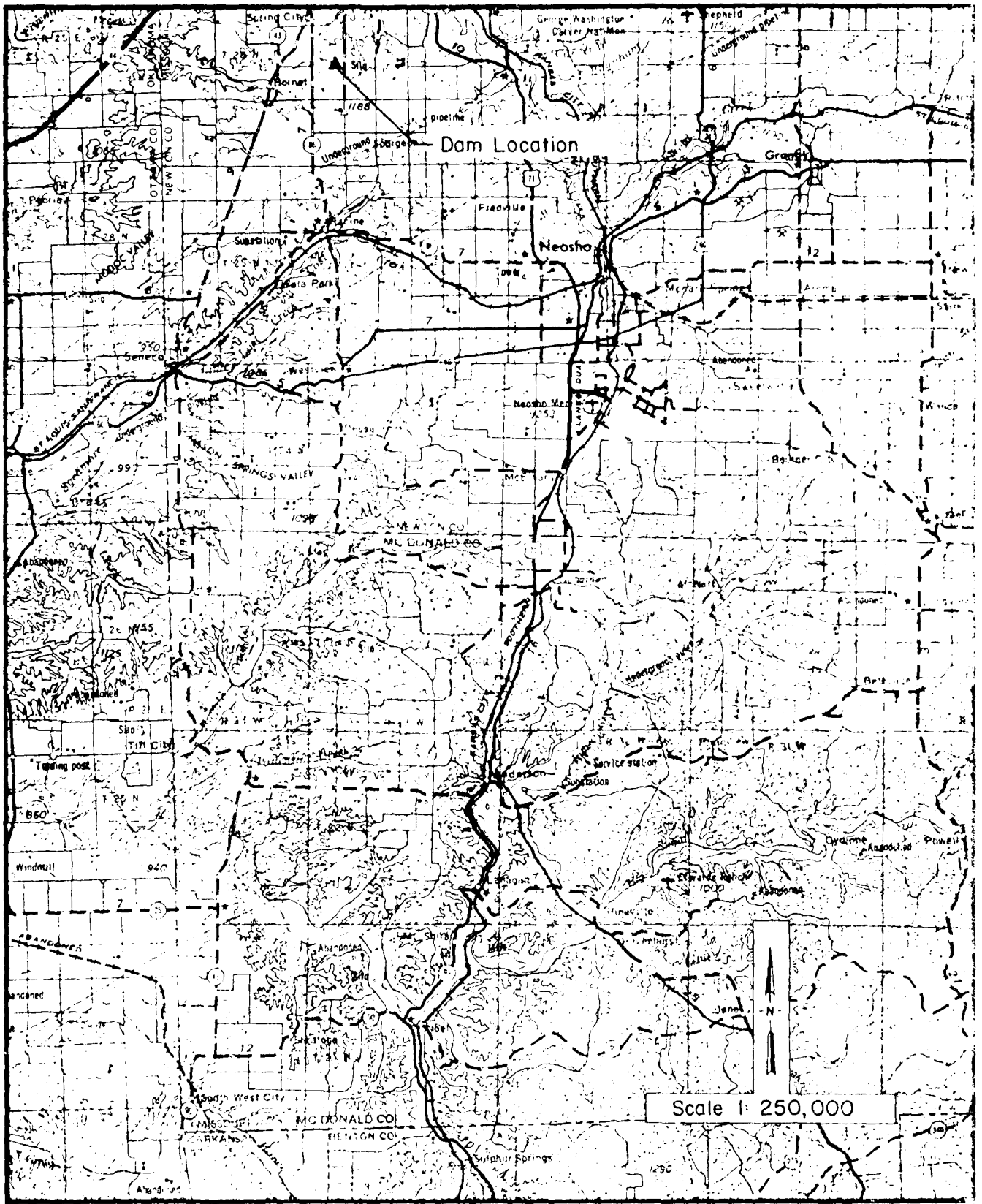


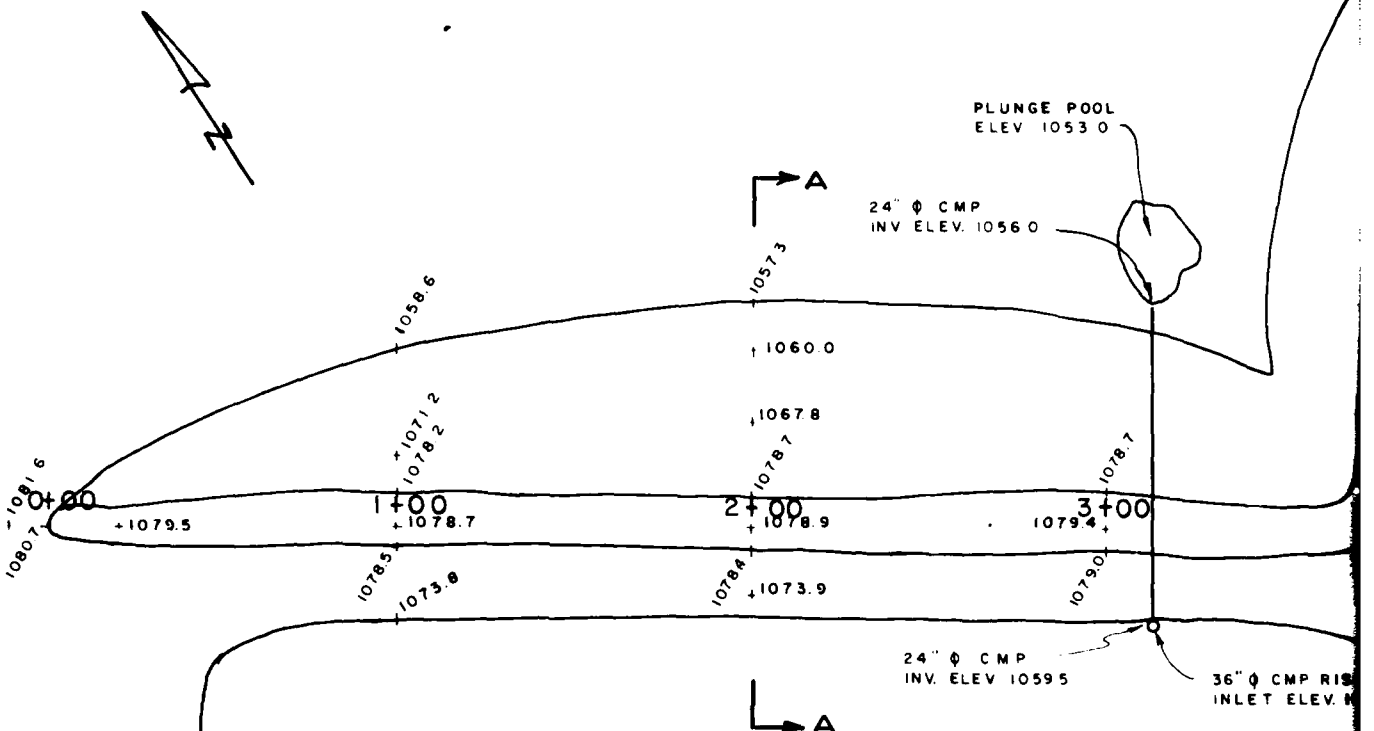
VICINITY MAP

HANSON ENGINEERS

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Lake Mintahama Dam
Newton County, Missouri
Mo. I.D. No. 20280

Sheet 2, Appendix A

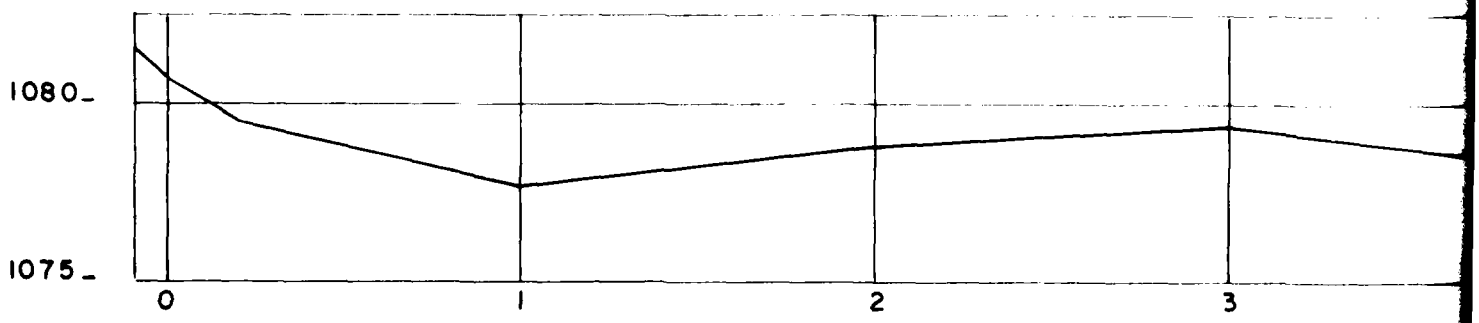


BENCHMARK:
TOP OF 36" DIA. CMP RISER
STA 3+12, 25 FT. RIGHT OF
CENTERLINE.
ELEV. 1073.1 M S L.

LAKE

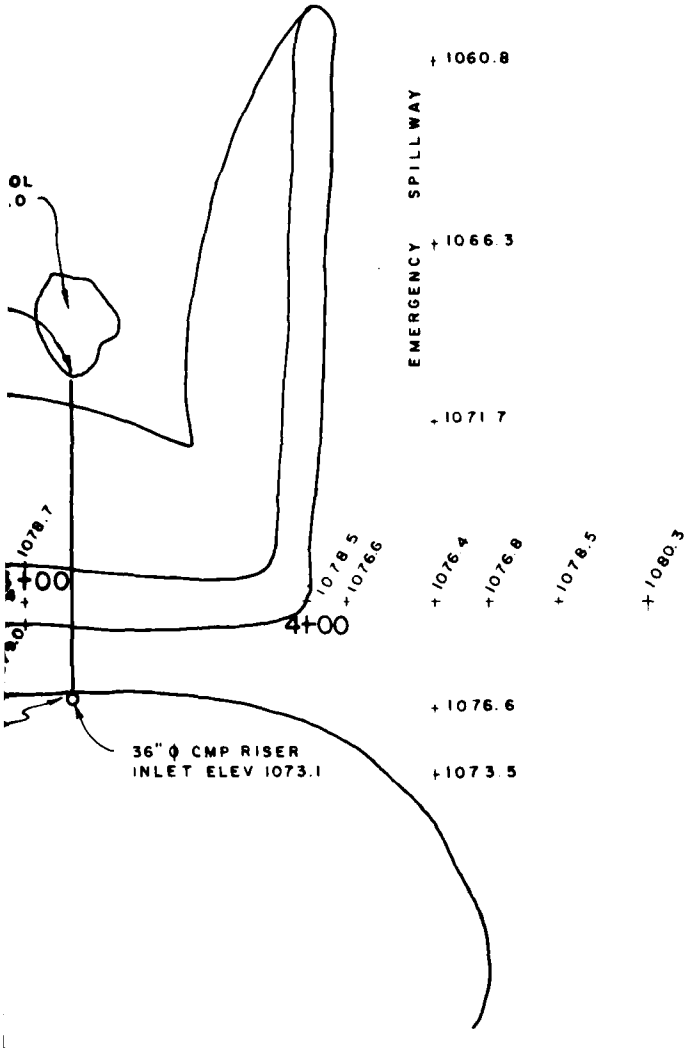
PLAN VIEW

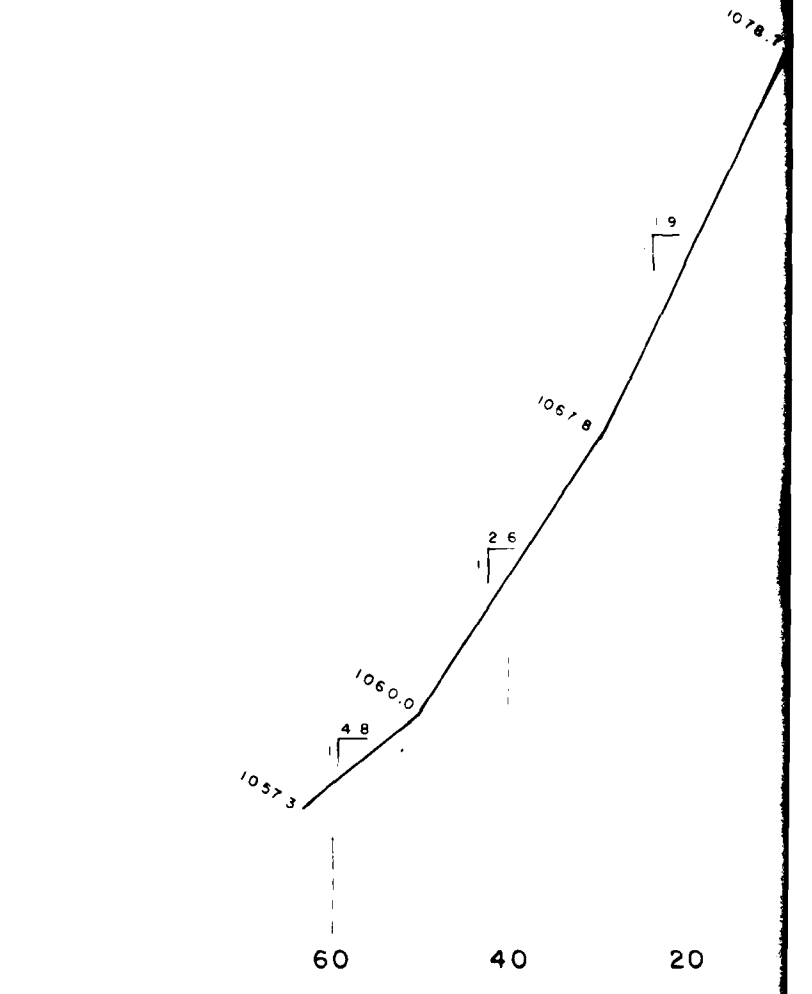
SCALE: 1" = 50'



PROFILE

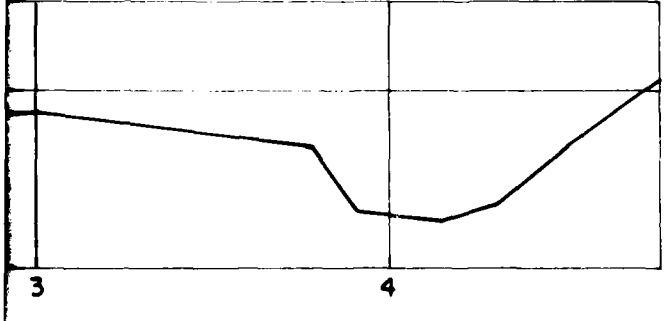
SCALE: HORZ 1" = 50'
VERT 1" = 5'





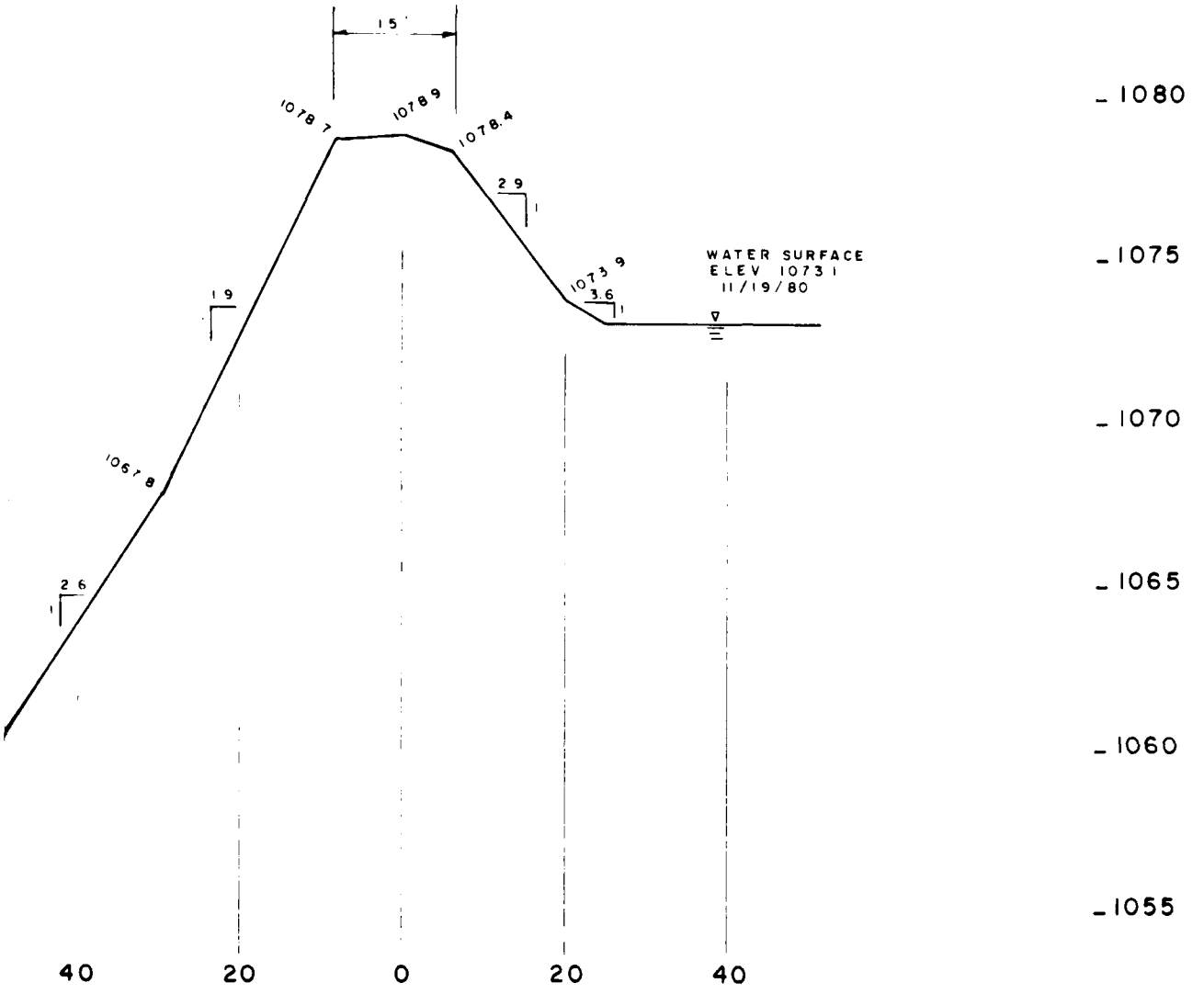
SECTION A

SCALE HORZ
VERT



10 80

10 75



SECTION A-A STA 2+00

SCALE HORZ 1" = 20'
VERT 1" = 5'

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LAKE MINTAHAMA DAM

MO. No. 20280

PLAN & PROFILE

NEWTON COUNTY, MO.

SHEET 3, APPENDIX A

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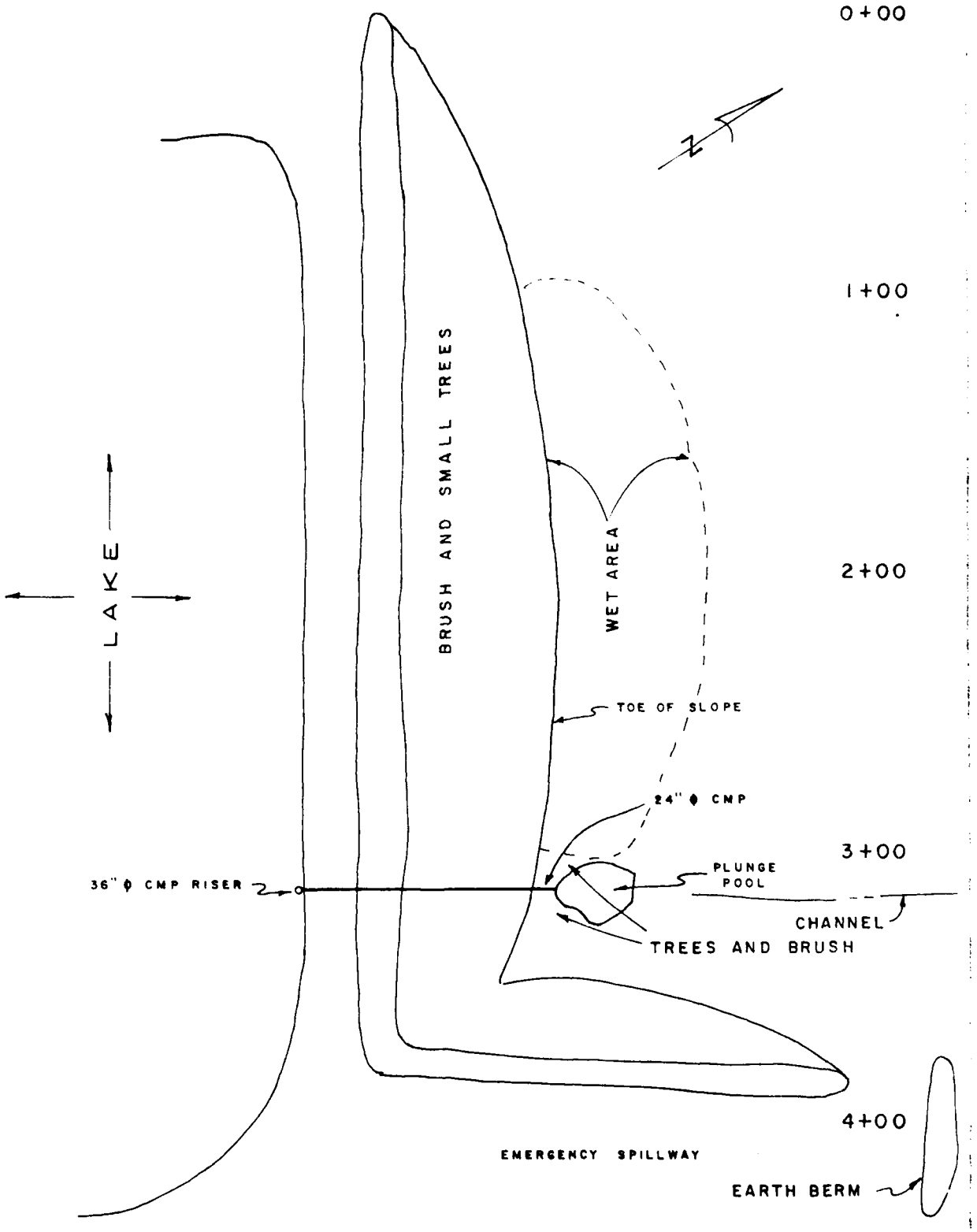
LAKE MINTAHAMA DAM
NEWTON COUNTY, MISSOURI
MO. I.D. No. 20280

EMERGENCY SPILLWAY
SECTION & PROFILE



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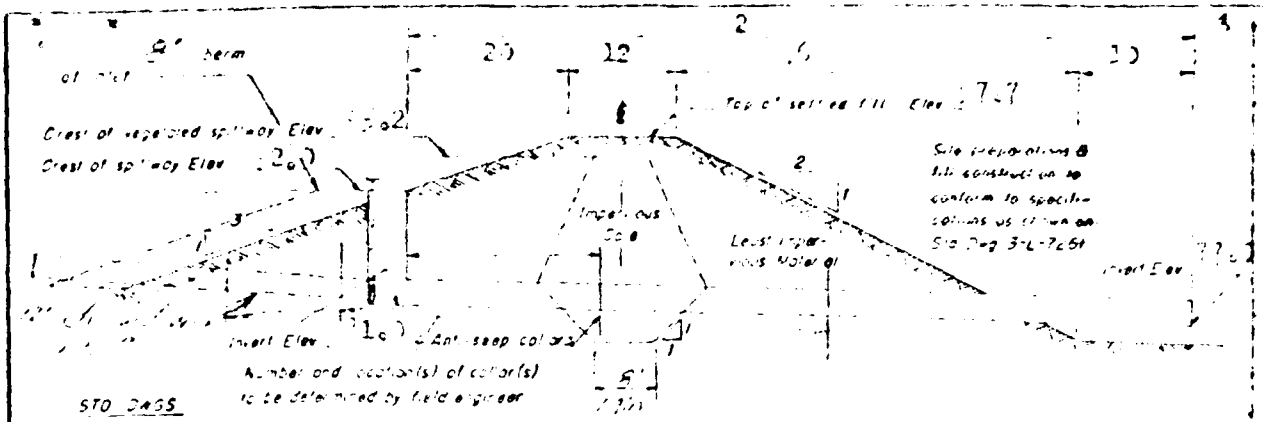
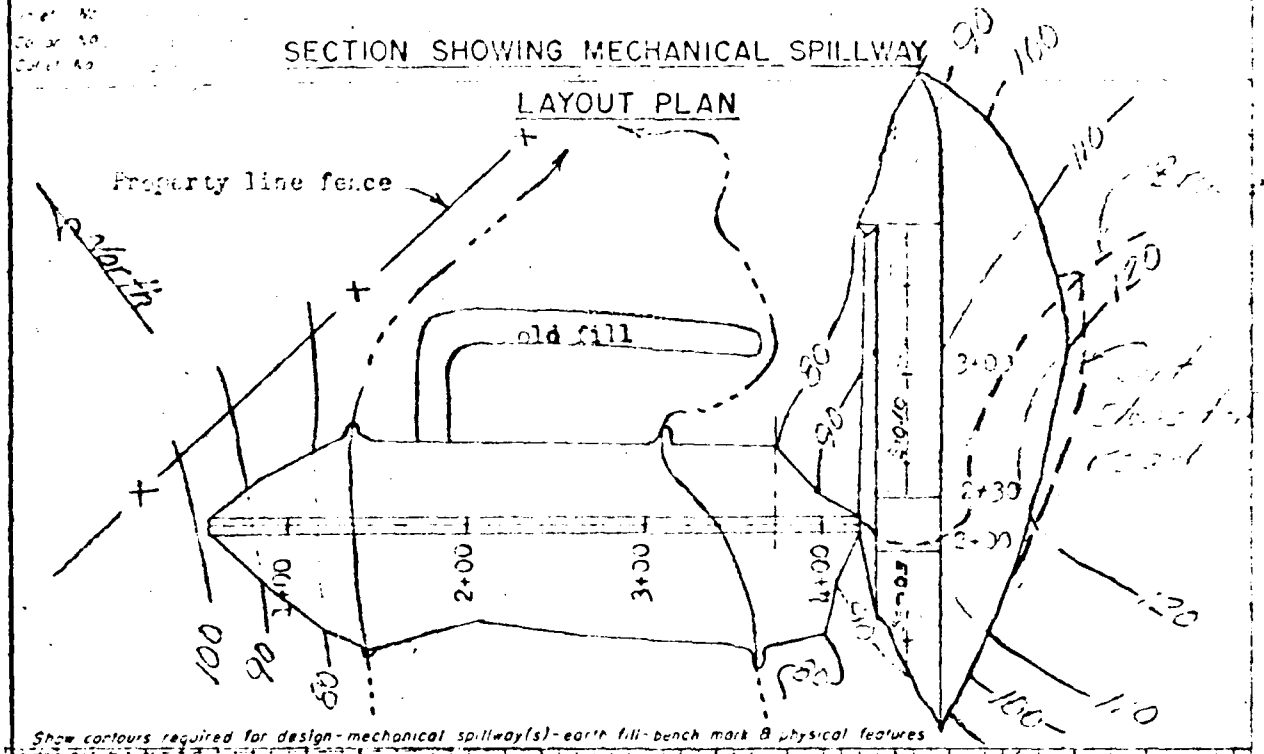
PLAN SKETCH OF DAM

LAKE MINTAHAMA DAM
NEWTON COUNTY, MISSOURI
MO. I. D. No. 20280



SECTION SHOWING MECHANICAL SPILLWAY

LAYOUT PLAN



Show contours required for design - mechanical spillway(s) - earth fill - bench mark & physical features

CROSS-SECTION ALONG CENTERLINE OF FILL

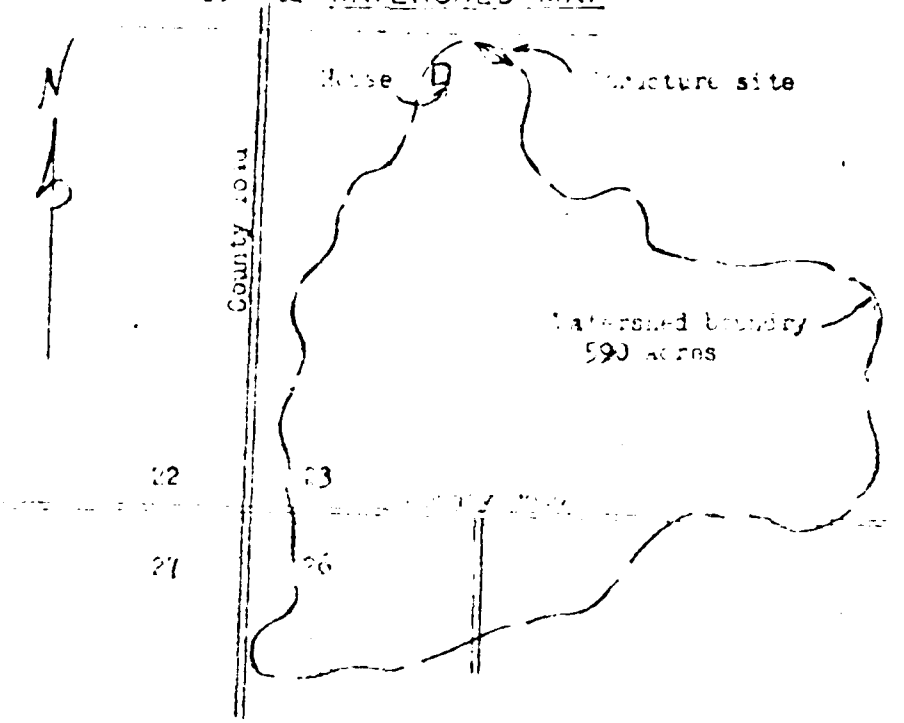
DRAINAGE AREA
SURFACE AREA
6 HOUR RAINFA
DESIGN RUNOFF
VOL FLOOD RU

PIPE FLOW
$Q_c = A\sqrt{\frac{2gH}{1+f\frac{K}{D}L}}$
H (TO EMER SP
Q_o/Q_i =
MAXIMUM STA
VOL FLOOD ST
=510

WEIR FLOW
WEIR SIZE L=
$Q = 3.4\ LH^{3/2}$
STAGE INLET
EMERGENCY S
DESIGN Q= 4
WIDTH (L)= 35
FREEBOARD R

Sheet

14 WATERSHED MAP



SCALE 1 INCH = 2000 FT

DESIGN DATA

DRAINAGE AREA 590 ACS.

~~$\Sigma W = (R) \quad x(S) \quad + (V \cdot C) \quad + (S \cdot S) \quad \bullet$~~

$Q_p = (P) \quad x(R) \quad x(F) \quad \bullet$ 1.2 C.F.S.

SURFACE AREA PERM POOL • 2.2 ACS.

6 HOUR RAINFALL • 3.5 IN RUNOFF CURVE 62

DESIGN RUNOFF • 1.00 IN

VOL FLOOD RUNOFF $(Vr) = \frac{1}{12} \times \frac{2.0}{} (DA) =$ 49.7 AC. FT

PIPE FLOW

$Q_c = A \sqrt{\frac{2gH}{1+1+KpL}} = (\quad) 8.02 \sqrt{\frac{H}{2+(\quad)}} =$ 1.2 CFS

H (TO EMER SPILLWAY) • 17.0 FT.

$Q_o/Q_i =$ 23.4 K • .577 (FROM 3-L-45245)

MAXIMUM STAGE 3.2 FT.

VOL FLOOD STORAGE REQ'D (Vs) • K x Vr • 27.8

.570 x 48.7 • 27.8 AC. FT.

WEIR FLOW

WEIR SIZE: L • _____ FT.; OR D • 36 IN.

$Q = 3.4 LH^{3/2}$ OR $(9.4 DH^{3/2})$

STAGE INLET TO EMERG. SPILLWAY • 3.2 FT.

EMERGENCY SPILLWAY $(Q = 2.75 LH^{3/2})$

DESIGN Q • 40 % OF Q 329 • 132 C.F.S.

WIDTH (L) • 35 FT DEPTH OF FLOW (H) • 1.5 FT

FREEBOARD REQUIRED • 1.0 FT.

ESTIMATED QUANTITIES

QUAN	UNIT	ITEM
92	ea.	24" 14 gage C.M. PIPE
12	ft.	36" 14 gage C.M. Pipe Riser
1	ea.	2'x7' anti-vortex baffle
3	ea.	5'x5' anti-seep collars
60	ft.	12" drawdown pipe
1/3	CY	CONCRETE
17,700	CY.	EARTHFILL (10% added for settlement)

seed-mulch & fertilizer is needed

NOTE - *Rivets in longitudinal seams of CMP conduit under watertight coupling band shall be omitted and seams welded inside and outside with a continuous 1/8" fillet weld.*

COOPERATOR Ozark Area Girl Scout Council

COOPERATING WITH Newton COUNTY SCD

STATE Missouri SEC 23, 26, 33

SURVEYED Tindall Rastorfer DATE 2-13-69

George

PIPE DROP INLET

for Farm Pond

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed Tindall 4-69 Approved L. J. Tindall Area Engr.

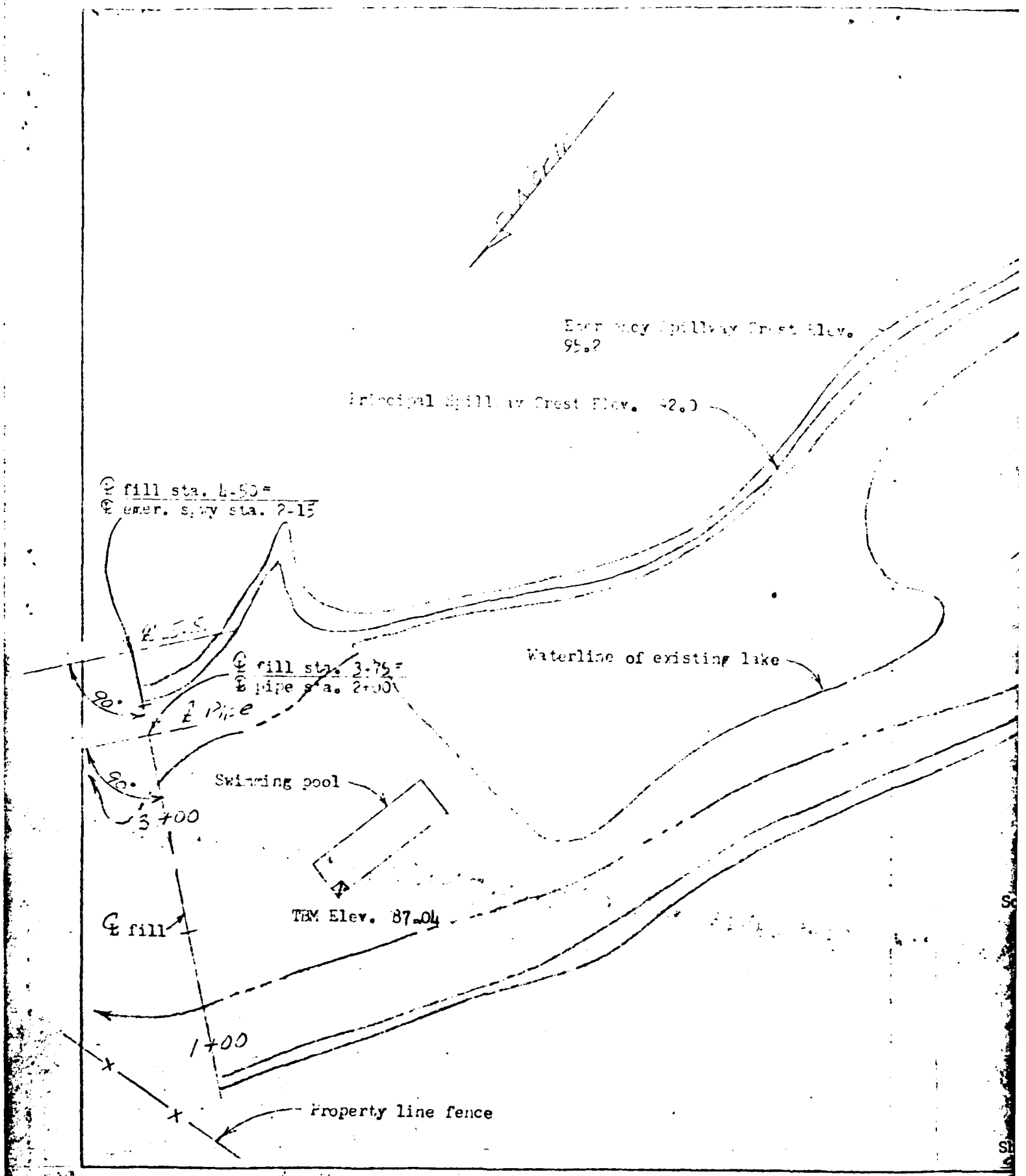
Drawn Rastorfer 4-69

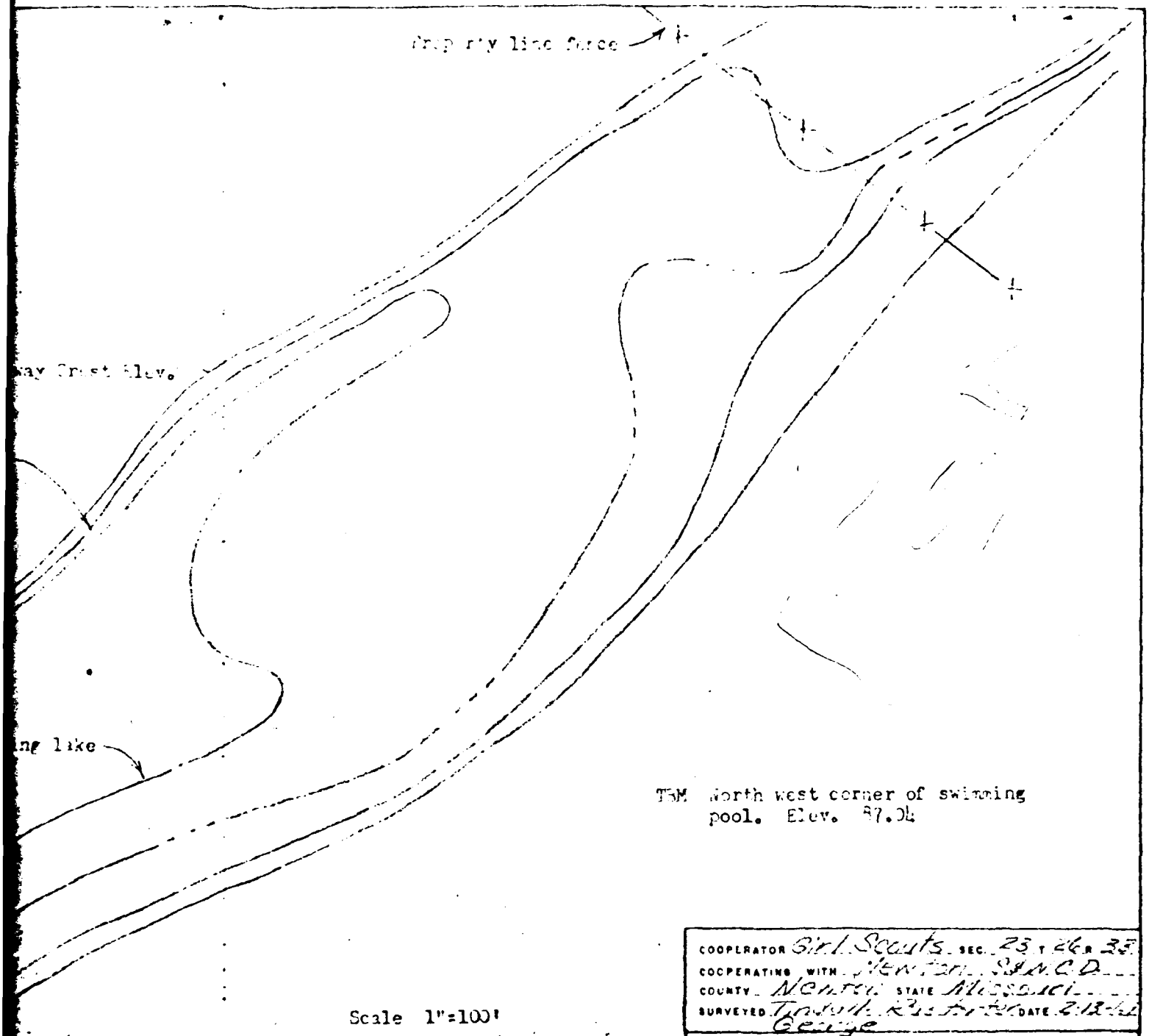
Traced Rastorfer 4-69

Checked Tindall 4-69

Sheet 6 Appendix A

ORDER THIS BLANK DATA SHEET BY DRAWING NUMBER 3-L-45245


Emergency Spillway Crest Elev. 95.2
Principal Spillway Crest Elev. 92.0
℄ fill sta. 4+50 =
℄ emer. spwy sta. 2+15
℄ fill sta. 3+75 =
℄ pipe sta. 2+00
Waterline of existing lake
90°
℄ pipe
90°
Swimming pool
3+00
TBM Elev. 87.04
℄ fill
1+00
Property line fence



Scale 1"=100'

COOPERATOR Girl Scouts SEC. 23 T 46 R 35
COOPERATING WITH Newton S.W.C.D.
COUNTY Newton STATE Missouri
SURVEYED Tindall, Rustin, Porter DATE 2-13-69
George

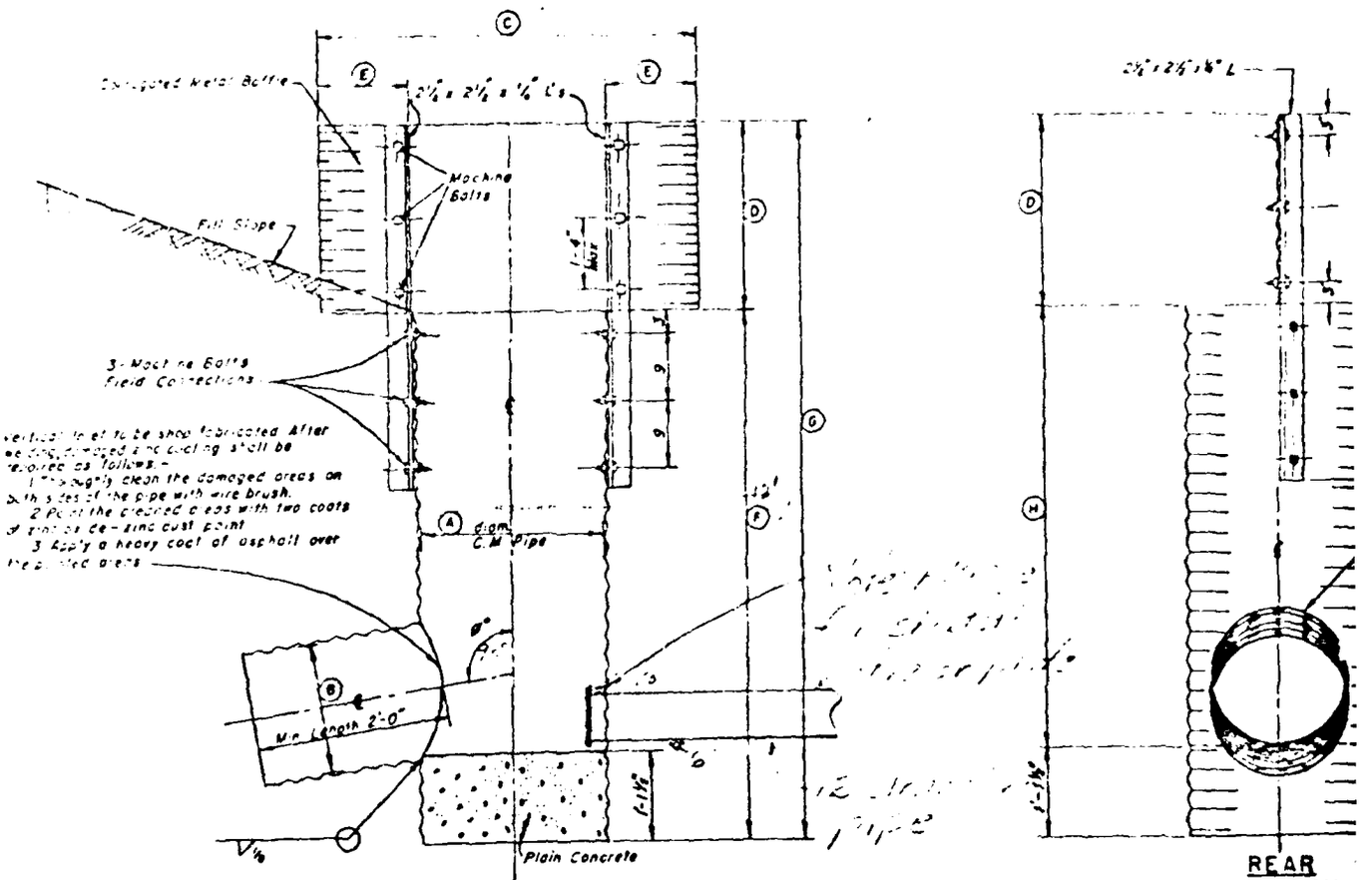
Pipe Drop Inlet for Farm Pond

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

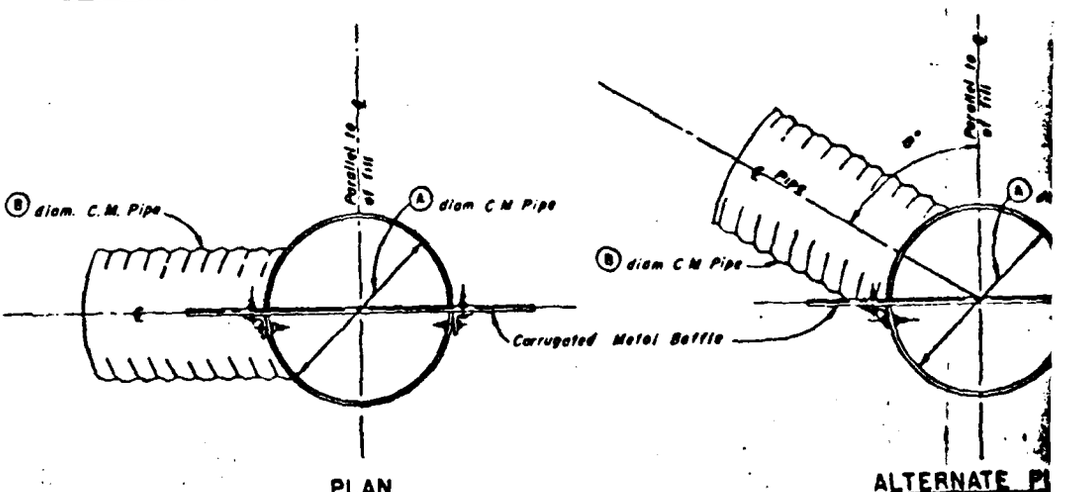
	Date		
Designed Tindall	4-69	Surveyed by L.J. Tindall	
Drawn A. Porter	4-69	Title Area Engr.	
Traced R. Porter	4-69	Title	
Checked TINDALL	4-69	Sheet No. 2 of 5	Drawing No.

Sheet 7, Appendix A

ORDER THIS BLANK DATA SHEET BY DRAWING NUMBER 3-N-5909



SECTION ON CENTERLINE



PLAN

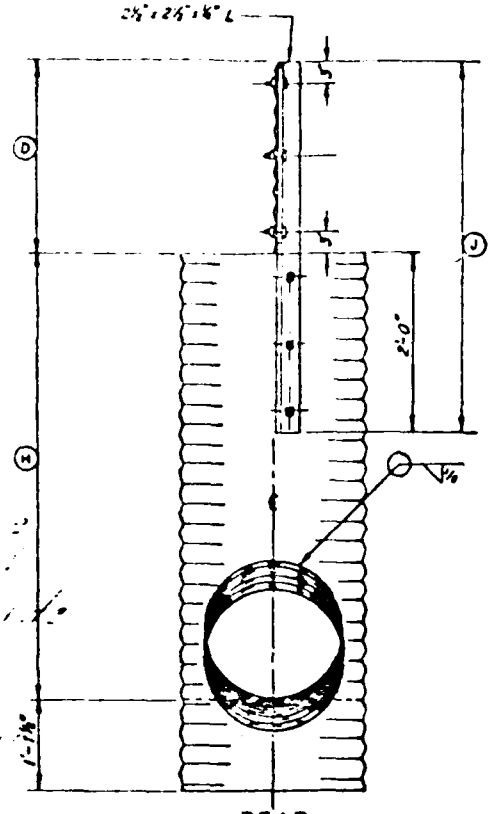
ALTERNATE PI
Use when pipe is ob

DETAILS OF INLET

E. B. W. P. UNIT-DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
DESIGNED BY	DRAWN BY Robert Thomas
CHECKED BY	STANDARD DWG. NO. 3-N-35176
DATE	SHEET 1 OF 1

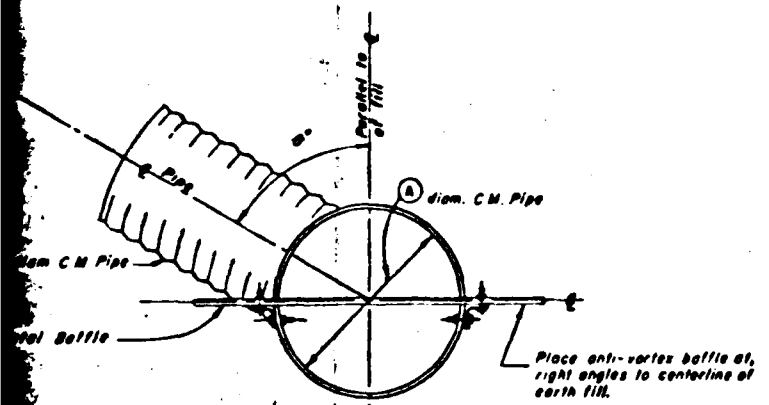
TABLE SHOWING DIMENSIONS AND MATERIAL	
Structure Number	
Gully or Lateral	
Station	
	DIMENSIONS
①	
②	
③	
④	
⑤	
⑥	
⑦	
⑧	
⑨	
⑩	
⑪	
CM Pipe Gage for ① diam	
CM Pipe Gage for ② diam	
CM Steel Gage for Baffle	
MATERIAL ITEMS	QUANTITIES REQ'D
2½" x 2½" x ¼" L x ③ Galv	2
② x ③ Corr Metal Sheets Galv	1
½" x 1¼" Steel Cadmium Plated Mach Bolts	4
½" Steel Split Lockwashers	4
½" Steel Cadmium Plated Nuts	4
⑧ degrees - angle	
⑨ degrees - angle	
Slope of ① diam pipe in "/in"	
Volume of Concrete in Cu Yds	1/3

NOTE All holes for bolts shall be 9/16 diam



REAR ELEVATION

Detail 36" Riser



ALTERNATE PLAN
Use when pipe is skewed.

INLET

DETAILS OF CORRUGATED METAL PIPE
VERTICAL INLET
WITH SHORT SPLITTER TYPE BAFFLE

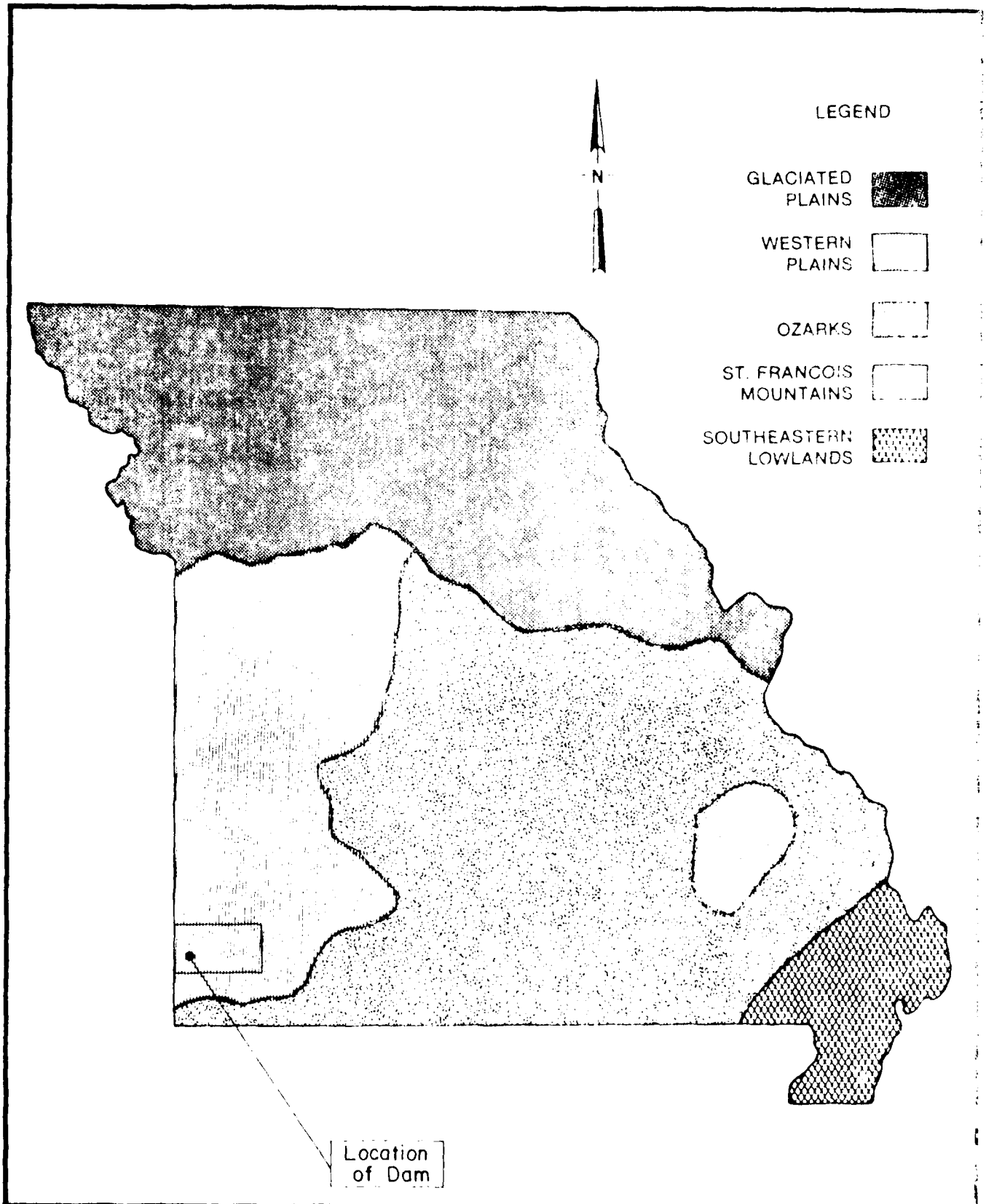
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED ... DATE ... APPROVED BY ...
DRAWN ... TITLE ...
TRACED ... SHEET ... DRAWING NO. ...
CHECKED ...

Rev. 12-8-60.
Rev 4-4-60

APPENDIX B

Geology and Soils



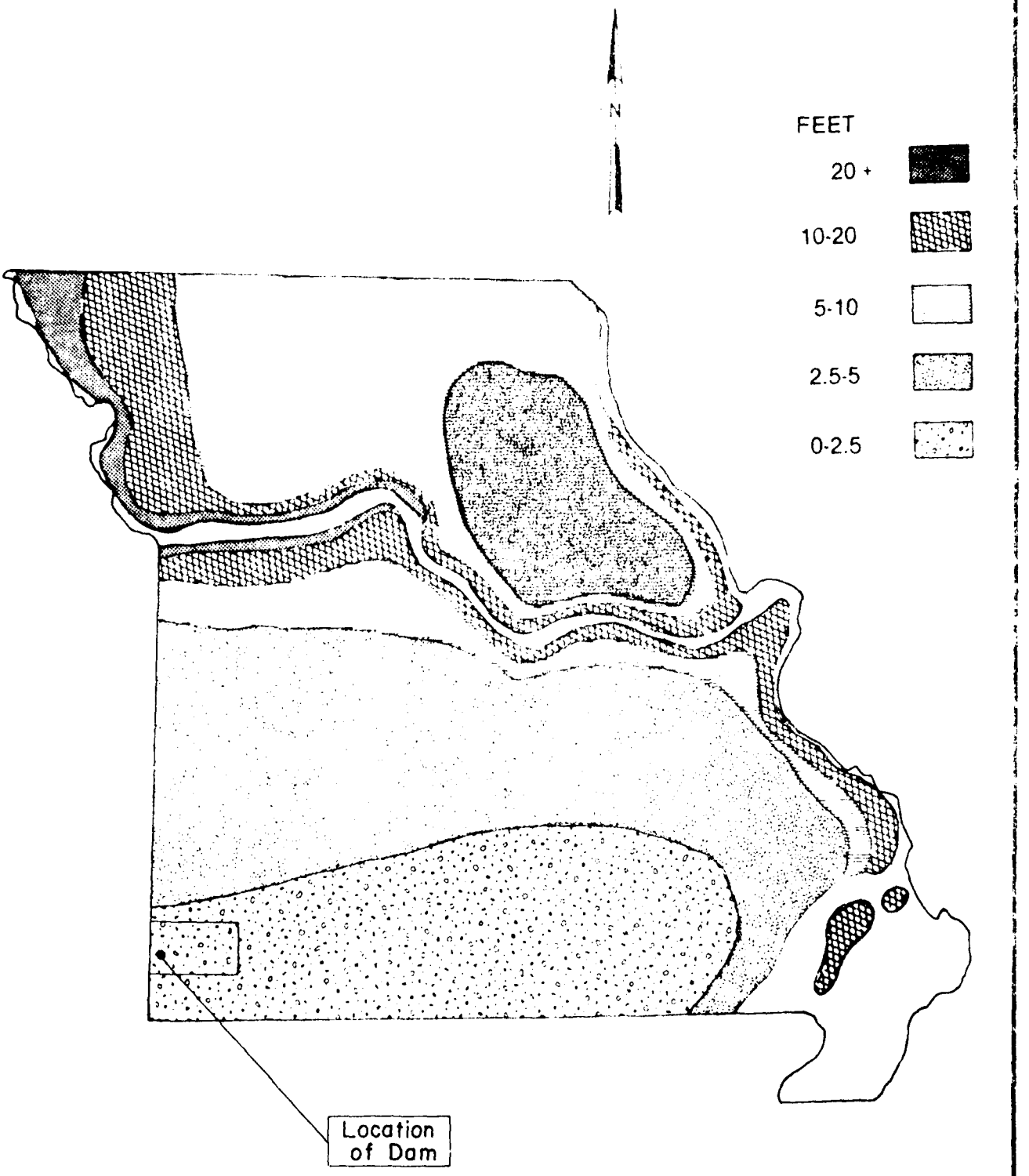
MAJOR GEOLOGIC REGIONS OF MISSOURI

HANSON ENGINEERS

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD IL

Lake Mintahama Dam
Newton County, Missouri
Mo. I.D. No. 20280

SHEET 1, APPENDIX B



THICKNESS OF LOESSIAL DEPOSITS

HANSON ENGINEERS

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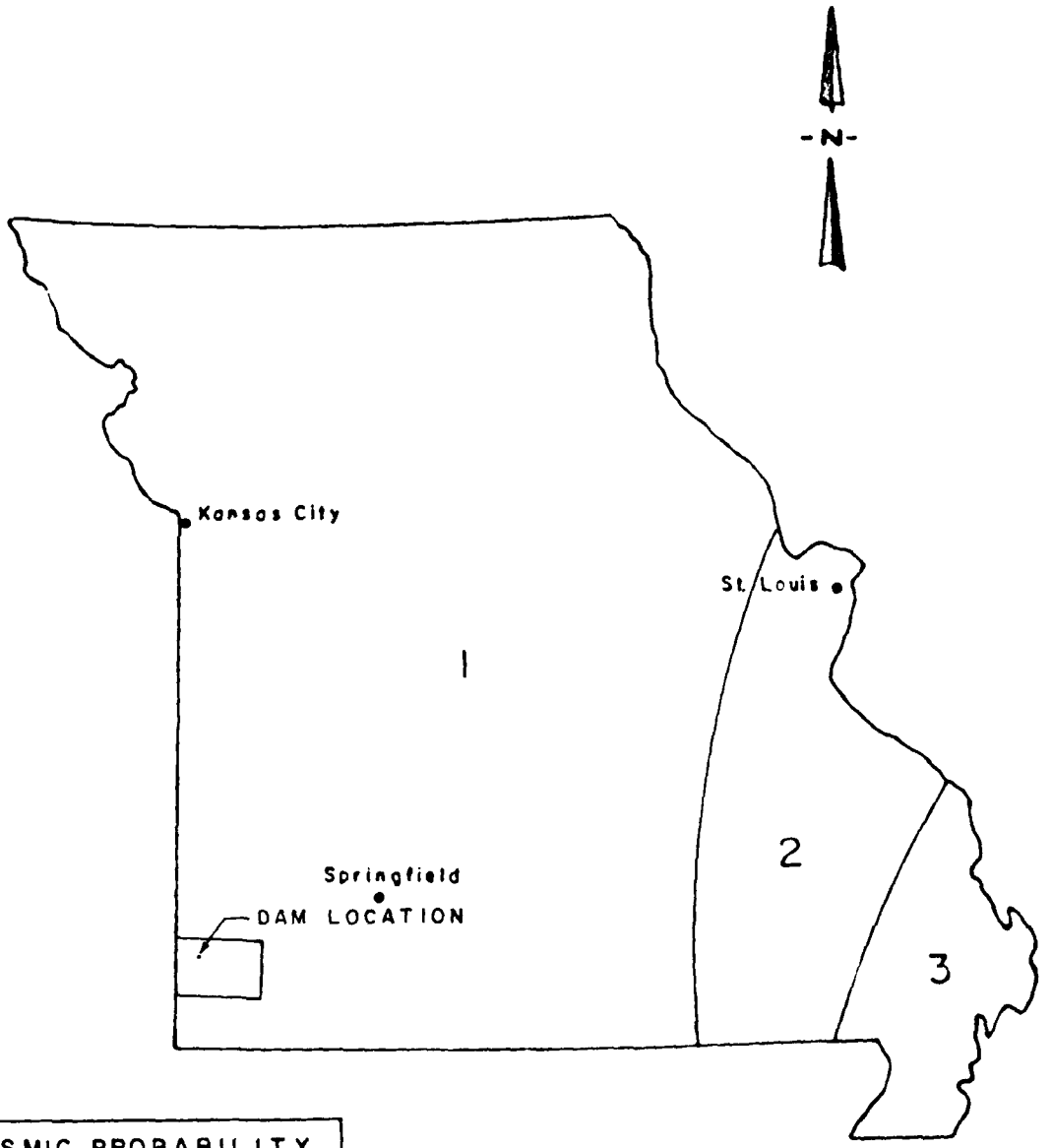
Lake Mintahama Dam
Newton County, Missouri
Mo. I.D. No. 20280

SHEET 2, APPENDIX B



SEISMIC PROBABILITY	
ZONE	DAMAGE
1	MINOR
2	MODERATE
3	MAJOR

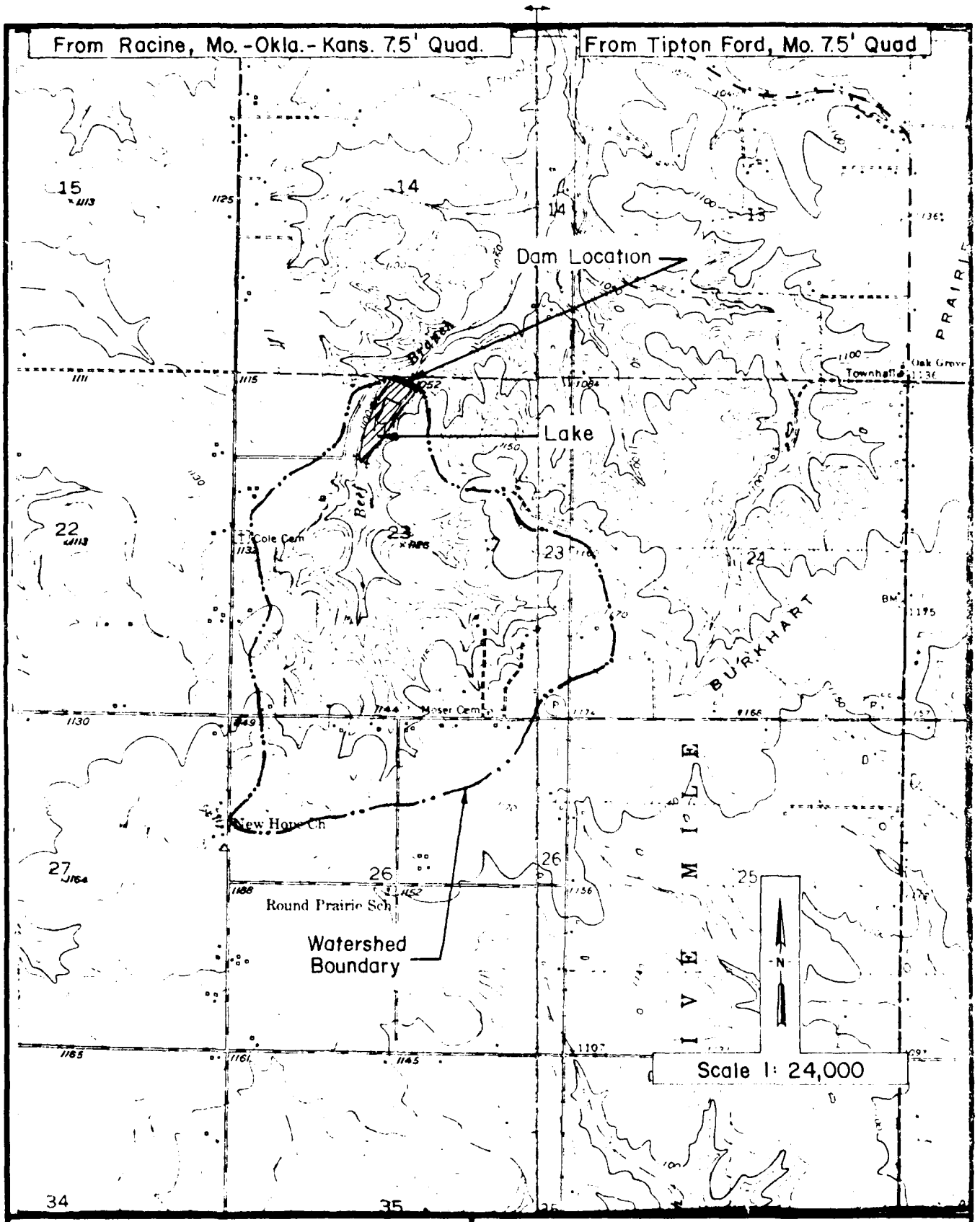
A/E ANDERSON ENGINEERING, INC.
730 N. BENTON AVE. • SPRINGFIELD, MO. 65802

SEISMIC ZONE MAP

LAKE MINTAHAMA DAM
NEWTON COUNTY, MISSOURI
MO. I.D. No. 20280

APPENDIX C

Overtopping Analysis



LAKE AND WATERSHED MAP

HANSON ENGINEERS

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Lake Mintahama Dam
Newton County, Missouri
Mo. I.D. No. 20280

Sheet 1, Appendix C

APPENDIX C

HYDROLOGIC AND HYDRAULIC ANALYSIS

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillway. The overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm duration was assumed according to the procedures outlined in EM 1110-2-1411 (SPD Determination). Also, the 1 percent chance and the 10 percent chance probability floods were routed through the reservoir and spillways. Joplin, Missouri rainfall distributions (6 min. interval - 24 hours duration), as provided by the St. Louis District, Corps of Engineers, were used in these cases.

The synthetic unit hydrograph for the watershed was developed by the computer program using the SCS method. The time of concentration was estimated using the Kirpich formula. This formula and the parameters for the unit hydrograph are shown in Table 1 (Sheet 4, Appendix C). The time of concentration was also verified from velocity estimates for the average slopes of the watershed and the main channel (Design of Small Dams, page 70, 1974 Edition).

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationship. The CN values used, and the result from the computer output, are shown in Table 2 (Sheet 5, Appendix C).

The reservoir routing was accomplished by using the Modified Puls Method assuming the starting lake elevation at normal pool. No antecedent storm was considered in this case. The hydraulic capacity of the spillway was used as an outlet control in the routing. The hydraulic capacity of the spillway and the storage capacity of the reservoir were defined by the elevation-surface area--storage-discharge relationships shown in Table 3 (Sheet 5, Appendix C).

The rating curve for the spillways is shown in Table 4 Sheet 6, Appendix C. For the principal spillway, weir control and outlet pipe control was assumed. For the emergency spillway, critical flow conditions over a trapezoidal broad-crested weir was assumed.

The flow over the crest of the dam during overtopping was determined using the non-level dam option ($L and $V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir. The lowest elevation of the crest of the dam, obtained from survey measurements, was assumed as top of dam elevation.

A summary of the routing analysis for different ratios of the PMF is shown in Table 5 (Sheet 7, Appendix C). The result of the routings indicates that the spillways will pass the 10 percent probability flood without overtopping the dam. The 1 percent probability flood will overlap the dam by 0.7 ft at elevation 1078.4 for one hour.

The computer input data, a summary of the output data, and a plot of the inflow-outflow hydrograph for the PMF are presented on Sheets 8, 9, and 10 of Appendix C. The computer input and output data for the 1 percent probability flood as shown in Sheets 11 and 12 of Appendix C.

TABLE 1

SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	0.92	sq miles
Length of Watercourse (L)	1.25	miles
Difference in elevation (H)	112	ft
Time of concentration (Tc)	0.55	hrs
Lag Time (Lg)	0.33	hrs
Time to peak (Tp)	0.38	hrs
Peak Discharge (Qp)	1,170	cfs
Duration (D)	6	min.

Time (Min.)(*)	Discharge (cfs)(*)	Time (Min.)(*)	Discharge (cfs)(*)
0	0	60	120
6	183	66	78
12	608	72	50
18	1,074	78	33
24	1,164	84	22
30	991	90	14
36	685	96	10
42	427	102	6
48	283	108	3
54	183		

(*) From the computer output

FORMULA USED:

$$Tc = \left(\frac{11.9\ L^3}{H} \right)^{0.385}$$

Kirpich Formula.
From California Culverts Practice, California Highways and Public Works, September, 1942.

$$Lg = 0.6\ Tc$$

$$Tp = \frac{D}{2} + Lg$$

$$Qp = \frac{484\ A.Q}{Tp}$$

Q = Excess Runoff = 1 inch

TABLE 2

RAINFALL-RUNOFF VALUES

Selected Storm Event	Storm Duration (Hours)	Rainfall (Inches)	Runoff (Inches)	Loss (Inches)
PMP	24	35.4	33.0	2.4
1% Prob. Flood	24	8.4	4.4	4.0
10% Prob. Flood	24	5.8	2.4	3.4

Additional Data:

1) Soil Conservation Service Soil Group B
2) Soil Conservation Service Runoff Curve CN = 82 (AMC III) for the PMF
3) Soil Conservation Service Runoff Curve CN = 65 (AMC II) for the 1 percent probability flood
4) Percentage of Drainage Basin Impervious 4 percent

TABLE 3

ELEVATION, SURFACE AREA, STORAGE AND DISCHARGE RELATIONSHIPS

Elevation (feet-MSL)	Lake Surface Area (acres)	Lake Storage (acre-ft)	Spillway Discharge (cfs)
1054.0	0	0	-
1070.0	6.4	51	-
*1073.1	8.2	74	0
**1076.6	10.8	107	45
***1078.7	14.0	133	545
1080.0	15.3	152	1,237
1082.0	18.0	185	2,938
1090.0	29.0	-	-

*Principal spillway crest elevation
**Emergency spillway crest elevation
***Top of dam elevation

The above relationships were developed using data from the USGS Racine, MO-OKLA.-KANS. and Tipton Ford, Missouri 7.5 minute quadrangle maps and the field measurements.

TABLE 4

SPILLWAYS RATING CURVE

Reservoir Elevation (MSL)	Principal Spillway (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
*1073.1	0	-	0
1073.5	7	-	7
1074.0	27	-	27
1074.5	43	-	43
1075.5	44	-	44
**1076.6	45	0	45
1077.5	46	120	166
***1078.7	47	498	545
1080.0	48	1,189	1,237
1081.0	50	1,935	1,985
1082.0	52	2,886	2,938

*Principal spillway crest elevation
**Emergency spillway crest elevation
***Top of dam elevation

Method Used:

1) Principal Spillway: Assuming weir control (up to elev. 1074.0) and outlet pipe control (also entrance control for checking) using charts for corrugated metal pipes from the U. S. Bureau of Public Roads.

2) Emergency Spillway: Assuming critical flow conditions over a trapezoidal broad-crested weir.

Formula Used:

$$Q = C_2 . b . H_m^{1.5}$$

Q = Discharge in cfs

C_2 = Discharge coefficient from Table 8-7 page 8-58 (Handbook of Hydraulics by King-Brater)

b = bottom width of spillway channel (b = 40 ft, z = 9)

H_m = energy head

TABLE 5

RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (cfs)	Peak Lake Elevation (ft, MSL)	Total Storage (acre-ft)	Peak Outflow (cfs)	Depth (ft) Over Top of Dam
-	0	*1073.1	74	0	-
0.05	434	1077.2	115	127	-
0.10	869	**1078.7	133	545	0
0.15	1,303	1079.3	142	1,078	0.6
0.20	1,737	1079.6	147	1,595	0.9
0.30	2,606	1080.0	153	2,431	1.3
0.40	3,474	1080.3	163	3,154	1.6
0.50	4,343	1080.6	172	3,934	1.9
0.75	6,514	1081.3	193	5,996	2.6
1.00	8,685	1081.8	212	8,093	3.1

The percentage of the PMF that will reach the top of the dam is 10 percent.

*Principal spillway crest elevation
**Top of dam elevation

```
A       OVERTOPPING ANALYSIS FOR LAKE MINTAHAMA DAM ( # 1 )
A       STATE ID NO. 20280  COUNTY NAME : NEWTON
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB # 80S3001
B    240                6
B1     5
J      1        9        1
J1   .05      .10      .15      .20      .30      .40      .50      .75      1.0
K      0        1                                  3        1
K1      INFLOW HYDROGRAPH COMPUTATION **
M      1        2     0.92              0.92        1                          1
P      0     27.2      102      120      130
T                                                              -1      -82              0.04
W2  0.55     0.33
X      0     -.1        2
K      1        2                           0        4        1
K1      RESERVOIR ROUTING BY MODIFIED PULS AT DAM SITE **
Y                                   1        1
Y1     1                                                      74       -1
Y41073.1  1073.5  1074.0  1074.5  1075.5  1076.6  1077.5  1078.7  1080.0  1081.0
Y41082.0
Y5     0        7       27       43       44       45      166      545     1237     1985
Y5  2938
$S     0       51       74      107      133      152      185
$E1054.0  1070.0  1073.1  1076.6  1078.7  1080.0  1081.0  1082.0
$$1073.1
$D1078.7
$L     0      145      340      360      370      380      390
$V1078.7  1078.9  1079.4  1079.5  1080.0  1080.7  1082.0
K     99
```

PMF RATIOS
INPUT DATA

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				0.05	0.10	0.15	0.20	0.30	0.40	0.50	0.75	1.00
HYDROGRAPH AT	1	0.92	1	434.	869.	1303.	1737.	2606.	3474.	4343.	6514.	8685.
	(	2.38)	(	12.30)(	24.59)(	36.89)(	49.19)(	73.78)(	98.38)(	122.97)(	184.45)(	245.94)
ROUTED TO	2	0.92	1	127.	580.	1078.	1595.	2431.	3154.	3934.	5996.	8093.
	(	2.38)	(	3.60)(	16.43)(	30.52)(	45.17)(	68.83)(	89.32)(	111.41)(	169.79)(	229.18)

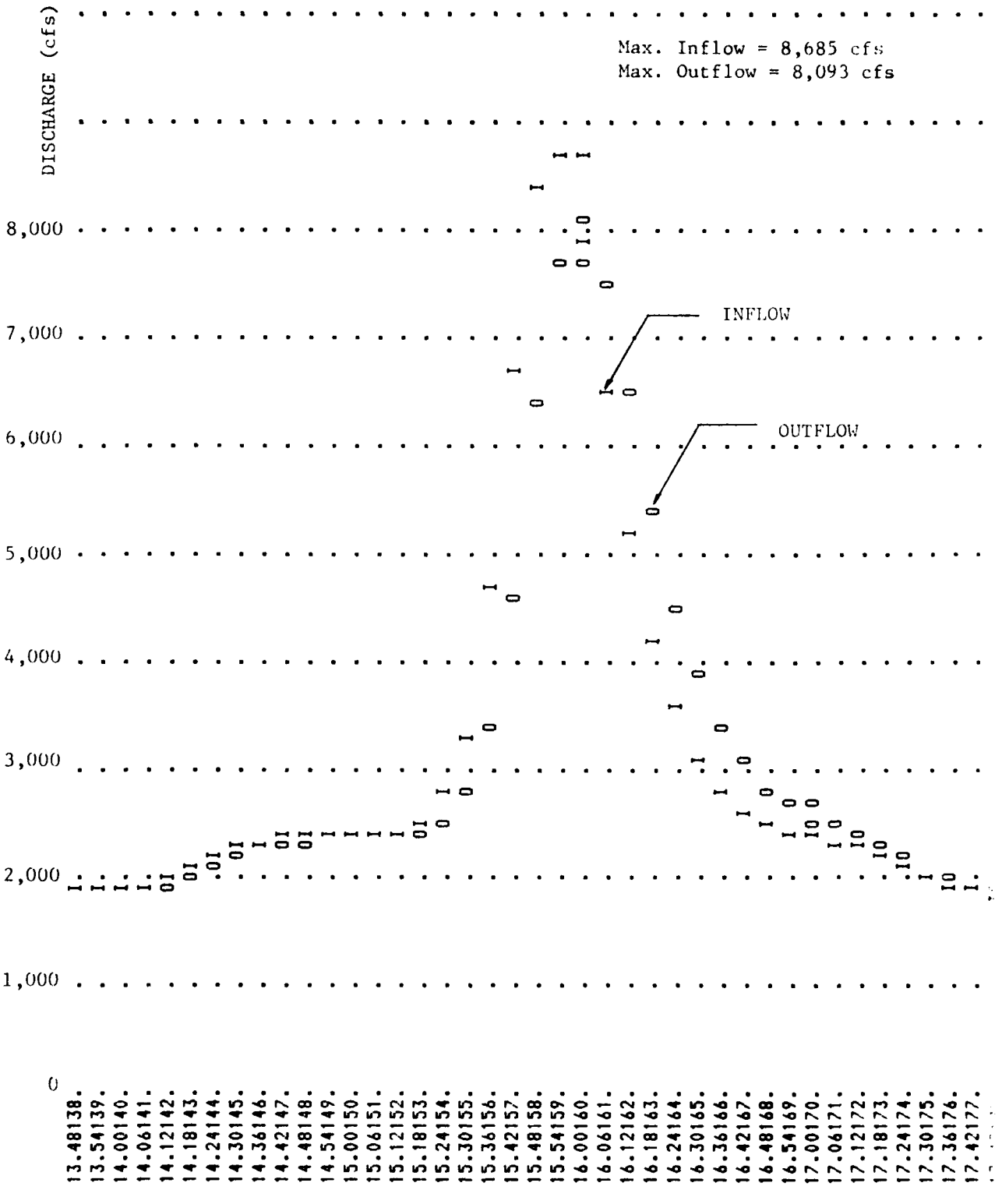
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1073.10	1073.10	1078.70
STORAGE	74.	74.	133.
OUTFLOW	0.	0.	545.

PMF RATIOS
OUTPUT DATA

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.05	1077.21	0.00	115.	127.	0.00	16.80	0.00
0.10	1078.76	0.06	134.	580.	0.30	16.20	0.00
0.15	1079.31	0.61	142.	1078.	0.90	16.10	0.00
0.20	1079.64	0.94	147.	1595.	1.50	16.00	0.00
0.30	1080.04	1.34	153.	2431.	4.00	16.00	0.00
0.40	1080.32	1.62	163.	3154.	5.10	16.00	0.00
0.50	1080.60	1.90	172.	3934.	5.70	16.00	0.00
0.75	1081.25	2.55	193.	5996.	6.50	16.00	0.00
1.00	1081.81	3.11	212.	8093.	7.10	16.00	0.00



INFLOW-OUTFLOW HYDROGRAPH FOR THE PMF

```
A       OVERTOPPING ANALYSIS FOR LAKE MINTAHAMA DAM ( N 1 ) (1 % PROB. FLOOD)
A       STATE ID NO. 20280  COUNTY NAME : NEWTON
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB # 80S3001
B    240                6
B1     5
.       1        1        1
.1   1.0
K       0        1                                  3        1
K1       INFLOW HYDROGRAPH COMPUTATION **
M       0        2    0.92              0.92        1                    1
O    240    8.386
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .019     .019     .019     .019     .019     .019     .019     .019     .019     .019
O1  .019     .019     .019     .019     .019     .019     .019     .019     .019     .019
O1  .019     .019     .019     .019     .019     .019     .019     .019     .019     .019
O1  .033     .033     .033     .033     .033     .033     .033     .033     .033     .033
O1  .033     .033     .033     .033     .033     .045     .045     .045     .045     .045
O1  .100     .100     .100     .100     .100     .182     .182     .183     .346     .612
O1  .956     .410     .346     .183     .182     .100     .100     .100     .100     .100
O1  .045     .045     .045     .045     .045     .033     .033     .033     .033     .033
O1  .033     .033     .033     .033     .033     .033     .033     .033     .033     .033
O1  .019     .019     .019     .019     .019     .019     .019     .019     .019     .019
O1  .019     .019     .019     .019     .019     .019     .019     .019     .019     .019
O1  .019     .019     .019     .019     .019     .019     .019     .019     .019     .019
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1  .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
T                                                          -1      -65              0.04
W2 0.55     0.33
X       0      -.1        2
K       1        2                          0        4        1
K1       RESERVOIR ROUTING BY MODIFIED PULS AT DAM SITE **
Y                                    1        1
Y1      1                                                  74       -1
Y41073.1  1073.5   1074.0   1074.5   1075.5   1076.6   1077.5   1078.7   1080.0   1081.0
Y41082.0
Y5      0        7       27       43       44       45      166      545     1237     1985
Y5   2938
$S      0       51       74      107      133      152      185
$E1054.0  1070.0   1073.1   1076.6   1078.7   1080.0   1081.0   1082.0
$$1073.1
$D1078.7
$L      0      145      340      360      370      380      390
$V1078.7  1078.9   1079.4   1079.5   1080.0   1080.7   1082.0
K      99
```

1 PERCENT PROBABILITY FLOOD
INPUT DATA

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

				RATIOS APPLIED TO FLOWS
OPERATION	STATION	AREA	PLAN	RATIO 1
				1.00
HYDROGRAPH AT	1	0.92	1	1716.
	(	2.38)	(	48.59)(
ROUTED TO	2	0.92	1	1197.
	(	2.38)	(	33.90)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1073.10	1073.10	1078.70
STORAGE	74.	74.	133.
OUTFLOW	0.	0.	545.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1079.39	0.69	143.	1197.	1.00	12.70	0.00

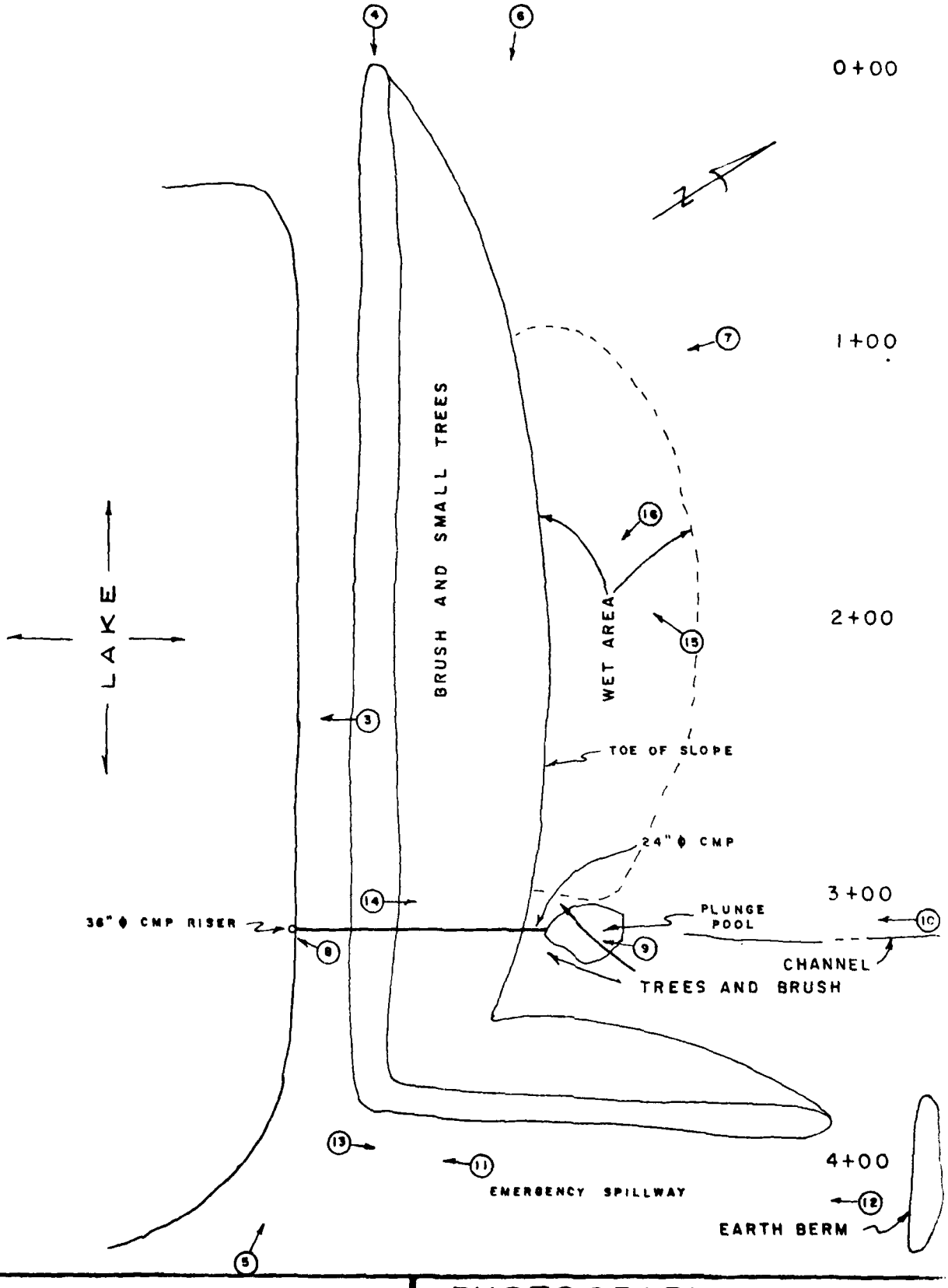
1 PECENT PROBABILTY FLOOD
OUTPUT DATA

APPENDIX D

Photographs

LIST OF PHOTOGRAPHS

NO.	DESCRIPTION
1	Aerial view of dam (Looking South)
2	Aerial view of lake and dam (Looking North)
3	View of reservoir (Looking South)
4	Crest of dam (Looking East)
5	View of dam, emergency spillway in foreground (Looking West)
6	Downstream slope, note trees and brush (Looking East)
7	View of downstream slope showing brush (Looking South)
8	Principal spillway inlet (Looking South)
9	Principal spillway outlet and plunge pool (Looking South)
10	Downstream spillway channel (Looking upstream South)
11	Emergency spillway inlet channel (Looking Southwest)
12	Emergency spillway channel (Looking upstream South)
13	Downstream channel of emergency spillway (Looking North) Note earth berm at end of channel
14	Downstream channel of principal spillway (Looking North from crest of dam)
15	Marshy area immediately beyond toe of slope (Looking Southwest)
16	Close up of standing water in marshy area (Note staining of water)



A/E ANDERSON ENGINEERING, INC.
730 N. BENTON AVE. • SPRINGFIELD, MO. 65802

PHOTOGRAPH INDEX

LAKE MINTAHAMA DAM
NEWTON COUNTY, MISSOURI
MO. I.D. No. 20280

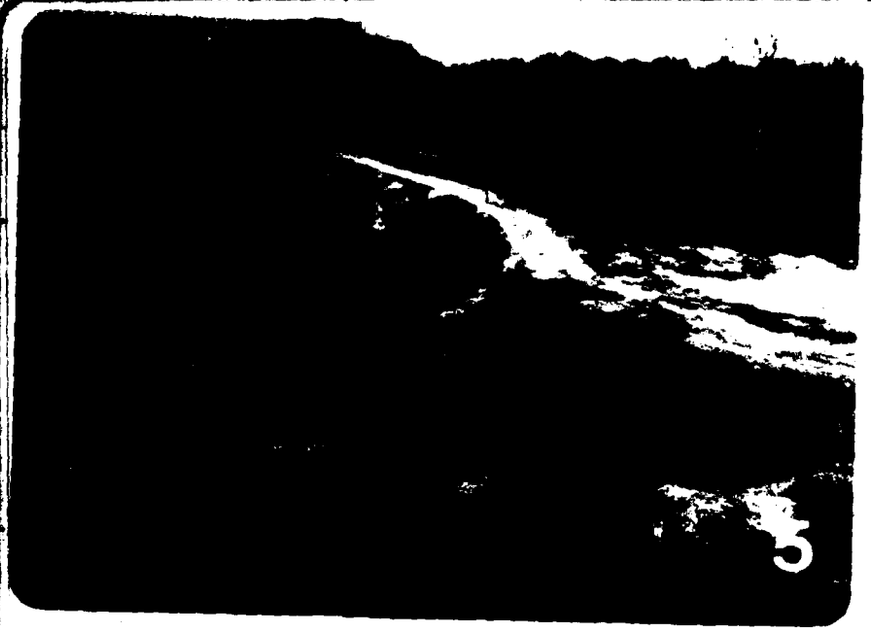
SHEET 2 , APPENDIX D


1


2


3


4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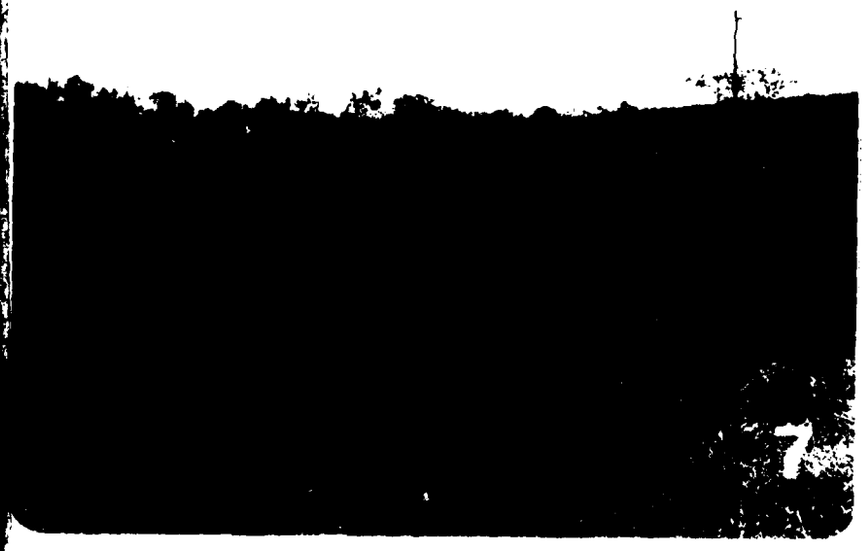
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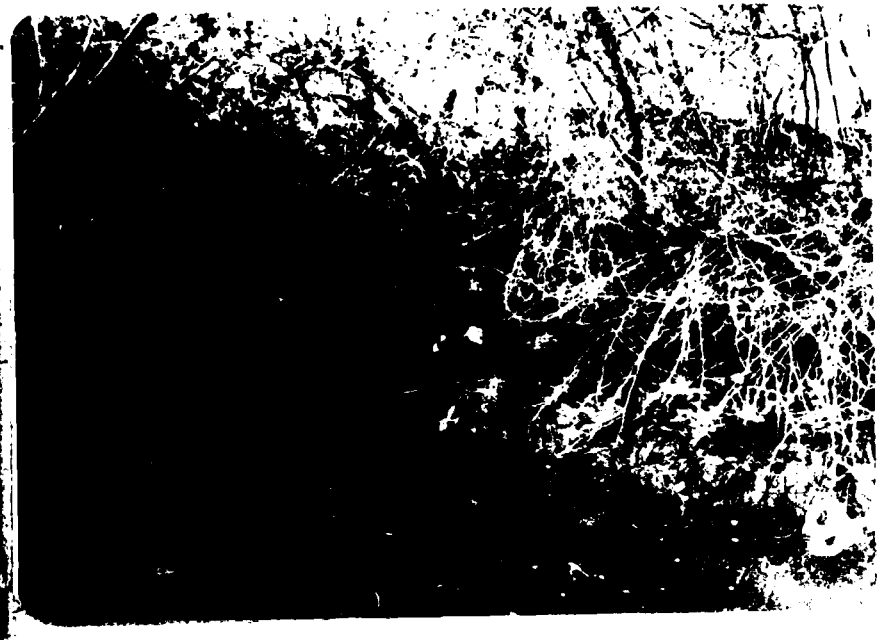


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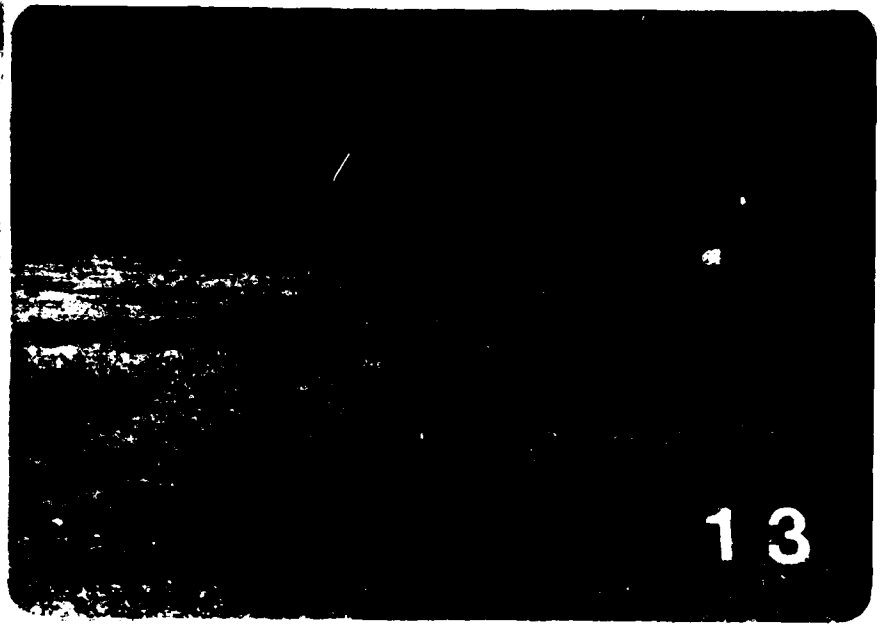
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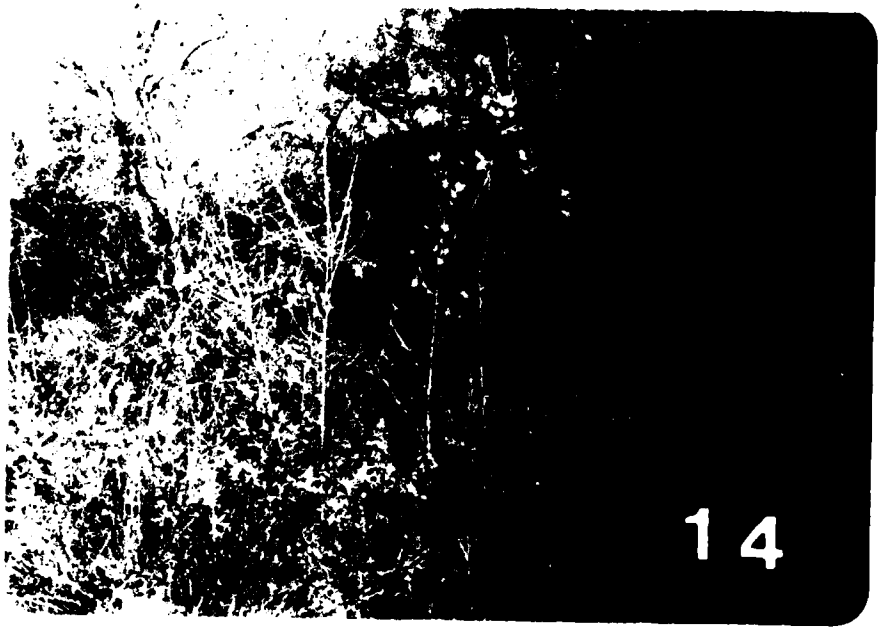
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